Post Office Order for 11s.

MAY 2 1881

No. 18. New Series. April 1881. [2s. 6d.

HARVARD COLLEGE LIBRARY

THE POPULAR Science Review

EDITED BY W. S. DALLAS, F.L.S.
Assistant-Secretary of the Geological Society.

HARVARD COLLEGE LIBRARY

CONTENTS.

The Myxomycetes or Mycetozoa; Animals or Plants?
By W. Saville Kent, F.L.S., F.Z.S., F.R.M.S. (Illustrated.)

The Permanence of Continents. By J. Starkie Gardiner, F.G.S.

Preliminary Note on the Existence of Ice and other Bodies in the Solid State at Temperatures far above their ordinary Melting Points. By Thomas Carnelly, D.Sc., Professor of Chemistry in Firth College, Sheffield. (Illustrated.)

On the Former Existence of the Roe-Deer in England.
By J. E. Harting, F.L.S., F.Z.S.

Contributions to the Knowledge of the Hottentot Race.
By M. J. A. Roonda Smit.

REVIEWS.
Animal Life—A Polar Reconnaissance—Helmholtz's Lectures—Nature's Hygiene—Physiological Chemistry—The Constitution of the Earth—Steam and the Steam-Engine—Extinct British Animals—The Christian Knowledge Society—Plant Life—Movements of Plants.

SCIENTIFIC SUMMARY.
Anthropology—Astronomy—Botany—Geology and Palæontology—Physics—Zoology.

ILLUSTRATED.

LONDON:
DAVID BOGUE,
3 ST. MARTIN'S PLACE, TRAFALGAR SQUARE.

LONDON: PRINTED BY STRANGEWAYS AND SONS, TOWER STREET, UPPER ST. MARTIN'S LANE.

First Series, edited by Dr. H. Lawson, may be had complete in numbers, price

F. & C. OSLER,

Glass Dinner Services.	China Dessert Services.
Glass Dessert Services.	China Dinner Services.
Glass Table Decorations.	China Breakfast Services.
Glass Flower Vases.	China Tea Services.
Glass Table Lamps.	China Vases.
Glass Lustres & Wall Lights.	China and Parian Groups.
Glass & Metal Chandeliers.	China Ornaments.

BIRMINGHAM:—Manufactory & Show Rooms, Broad Street.

LONDON:—Show Rooms, 45 Oxford Street, W.

NORTH BRITISH & MERCANTILE INSURANCE COMPANY.

Established in 1809.

CAPITAL, TWO MILLIONS.

Accumulated Life Funds	£2,852,566
Fire Reserve Fund	1,099,642

DIRECTORS.

Chairman.—JOHN WHITE CATER, Esq. *Deputy-Chairman.*—CHARLES MORRISON, Esq.

RICHARD BARING, Esq.	P. DU PRÉ GRENFELL, Esq.	GEORGE GARDEN NICOL, Esq.
RICHARD BRANDT, Esq.	QUINTIN HOGG, Esq.	JOHN SANDERSON, Esq.
A. H. CAMPBELL, Esq.	Hon. HUGH M'CULLOCH.	Baron J. H. W. SCHRODER.
EDWARD COHEN, Esq.	J. S. MORGAN, Esq.	GEORGE YOUNG, Esq.
	CHARLES W. MILLS, Esq.	

Manager of Fire Department—G. H. BURNETT. *Manager of the Life Department*—HENRY COCKBURN.
Secretary—F. W. LANCE.
Medical Officers—A. H. HASSALL, M.D.; R. C. CREAM, M.D.; HERMANN WEBER, M.D.
Solicitor—Sir W. R. DRAKE. *General Manager*—DAVID SMITH, F.R.S.E.

FIRE DEPARTMENT.

Property of every description, at home and abroad, insured at the most favourable rates.
The net premiums for 1878 amounted to £915,196.
Prospectuses and every information can be obtained at the CHIEF OFFICE.

LIFE DEPARTMENT.

The principles on which this Company was founded, and on which it continues to act, combine the system of mutual assurance with the safety of a large protecting capital and accumulated funds, and thus afford all the facilities and advantages which can prudently be offered by any life assurance office. Under these principles the business of the Company continues rapidly to increase.
Ninety per cent. of the whole profits is divided among the assurers on the participating scale.
The profits are divided every five years. Policies indisputable after five years.
Annuities of all kinds are granted, and the rates fixed on the most favourable terms.

LONDON—61 THREADNEEDLE STREET, E.C.
WEST END OFFICE—8 WATERLOO PLACE, S.W.
EDINBURGH—64 PRINCES STREET.

POPULAR SCIENCE REVIEW.

CONTENTS.—No. XVIII. NEW SERIES.

PAGE

THE MYXOMYCETES OR MYCETOZOA; ANIMALS OR PLANTS? By W. Saville Kent, F.L.S., F.Z.S., F.R.M.S. (Illustrated) .. 97

THE PERMANENCE OF CONTINENTS. By J. Starkie Gardiner, F.G.S. 117

PRELIMINARY NOTE ON THE EXISTENCE OF ICE AND OTHER BODIES IN THE SOLID STATE AT TEMPERATURES FAR ABOVE THEIR ORDINARY MELTING POINTS. By Thomas Carnelly, D.Sc., Professor of Chemistry in Firth College, Sheffield (Illustrated) 128

ON THE FORMER EXISTENCE OF THE ROE-DEER IN ENGLAND. By J. E. Harting, F.L.S., F.Z.S. 136

CONTRIBUTIONS TO THE KNOWLEDGE OF THE HOTTENTOT RACE. By M. J. A. Roonda Smit 147

REVIEWS:—

Animal Life—A Polar Reconnaissance—Helmholtz's Lectures—Nature's Hygiene—Physiological Chemistry—The Constitution of the Earth—Steam and the Steam-Engine—Extinct British Animals—The Christian Knowledge Society—Plant Life—Movements of Plants 160

SCIENTIFIC SUMMARY:—

Anthropology—Astronomy—Botany—Geology and Palæontology—Physics—Zoology 172

No notice can be taken of anonymous contributions. Contributors must write their names and addresses on the first page of MS. If accompanied with stamps, unsuitable manuscripts will always be carefully returned.

The Editor does not hold himself identified with the opinions expressed in contributions.

All communications to the Editor are to be addressed to 3 St. Martin's Place, Trafalgar Square.

Articles in the POPULAR SCIENCE REVIEW *are Copyright, and the Right of Translation is Reserved.*

MR. DAVID BOGUE'S LIST.

LITTLE WOMEN; or, Meg, Jo, Beth, and Amy. By LOUISA M. ALCOTT. Illustrated with 204 New and Original Woodcuts, and a Portrait of the Author. Fcap. 4to. cloth, 18*s.*

CONSCIOUS MATTER; or, the Physical and the Psychical Universally in Causal Connection. By W. STUART DUNCAN. Crown 8vo. cloth, 5*s.*

WAGNER'S LOHENGRIN. Musically and Pictorially Illustrated. The Legend and the Poem written and translated by JOHN P. JACKSON. With the Musical Gems of the Opera for Voice and Piano arranged by FRANCES MANETTE JACKSON. Royal 4to. sewed, 2*s.* 6*d.* (The Illustrated Opera Series, No. 1.)

KENNA'S KINGDOM: a Ramble through Kingly Kensington. By R. WEIR BROWN. With a Photograph of Holland House. Crown 8vo. cloth, 5*s.*

NATURE'S BYE-PATHS: A Series of Recreative Papers in Natural History. By J. E. TAYLOR, F.L.S., F.G.S., Editor of *Science Gossip.* Crown 8vo. cloth, 7*s.* 6*d.*

THE LAND AND FRESH WATER SHELLS OF THE BRITISH ISLES. By R. RIMMER, F.L.S. Illustrated with Eight Photographs and Three Lithographs containing figures of all the principal species. Crown 8vo. cloth, 10*s.* 6*d.*

UNCONSCIOUS MEMORY: a Comparison between the Theory of Dr. Ewald Hering, of Prague, and the 'Philosophy of the Unconscious' of Dr. Edward von Hartmann. With Translations from these Authors, and Preliminary Chapter bearing on 'Life and Habit,' and 'Evolution, Old and New.' By SAMUEL BUTLER, Author of 'Erewhon,' 'Life and Habit,' &c. Crown 8vo. cloth, 7*s.* 6*d.*

PRACTICAL DEMONSTRATIONS IN PHYSIOLOGICAL AND PATHOLOGICAL CHEMISTRY. Arranged to meet the requirements for the Practical Examination in these Subjects at the Royal College of Physicians and College of Surgeons. By CHARLES HENRY RALFE, M.A., M.D. Cantab; F.R.C.P. Lond.; Teacher of Physiological Chemistry, St. George's Hospital, &c., &c. Fcap 8vo. cloth, 5*s.*

THE HEART AND ITS FUNCTION. (Health Primers, No. 8.) Demy 16mo. cloth, Illustrated, 1*s.*

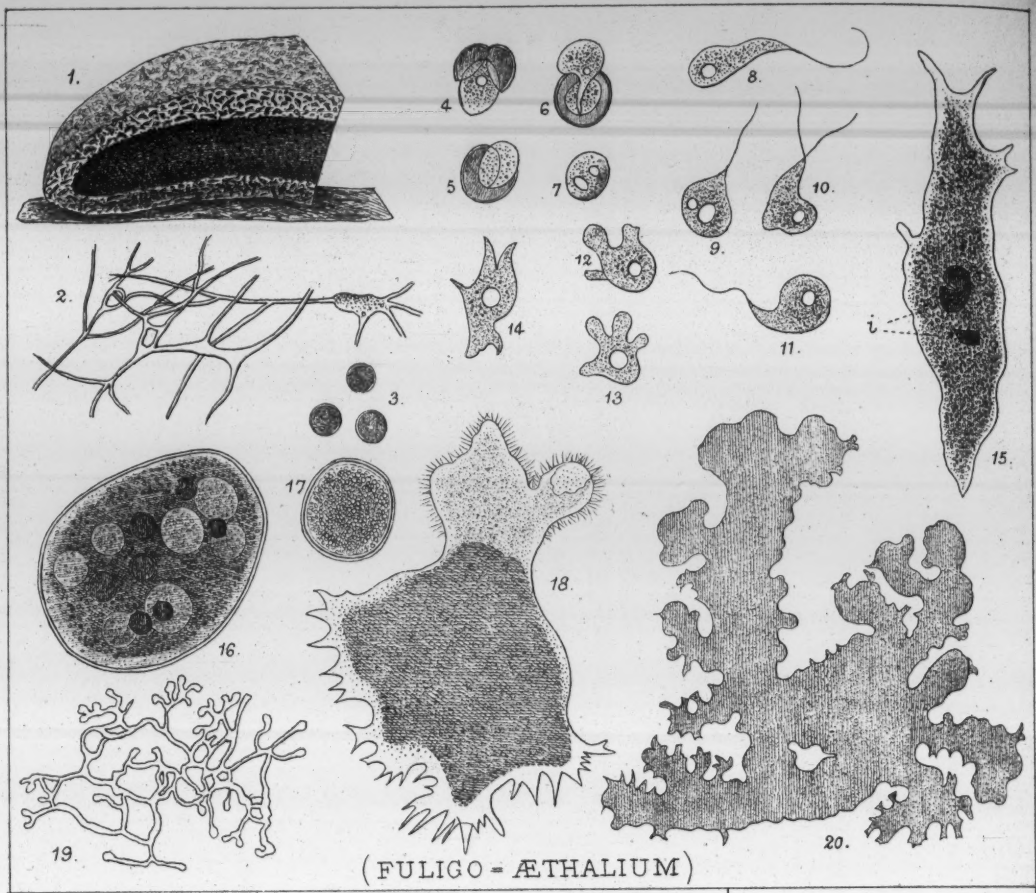
HOME NURSING, AND HOW TO HELP IN CASES OF ACCIDENT. By SAMUEL BENTON, L.R.C.P., M.R.C.S., Examiner to the St. John Ambulance Association, &c. Illustrated with Nineteen Woodcuts. Crown 8vo. cloth, 2*s.* 6*d.*

MUSIC AND MORALS. By the Rev. H. R. HAWEIS, M.A. Ninth Edition. Crown 8vo. cloth, 7*s.* 6*d.*

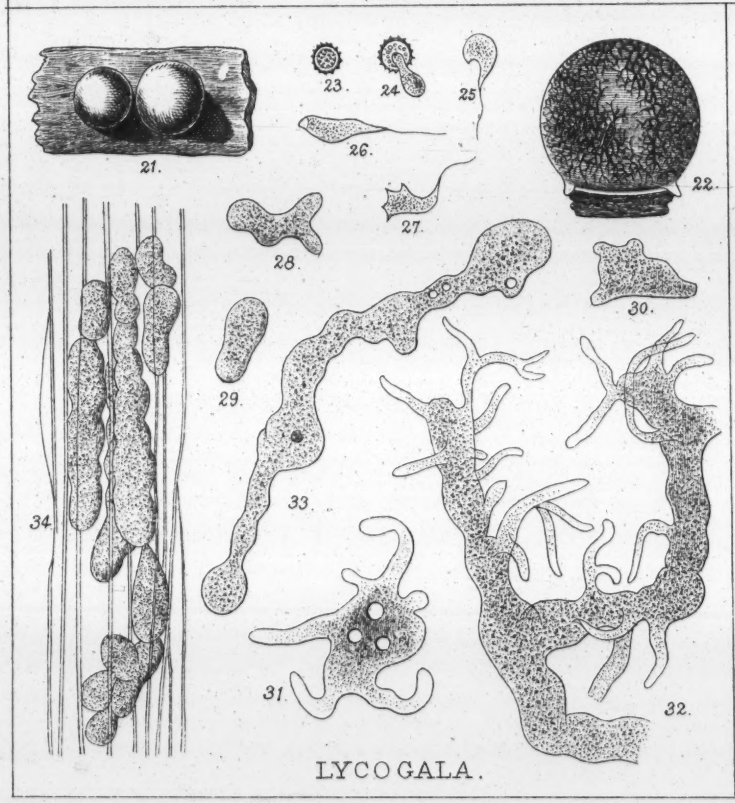
HOLIDAYS IN HOME COUNTIES. By EDWARD WALFORD, M.A. Contents:—A Day at Harold's Tomb—A Day at Stoke Pogis—St. Albans and Gorhambury—Footprints of Wolsey at Esher, &c., &c. With numerous Illustrations. Crown 8vo. cloth extra, 5*s.*

THE BYRON BIRTHDAY BOOK. Compiled and Edited by JAMES BURROWS. Second Edition. 16mo. morocco gilt edges, 3*s.* 6*d.*

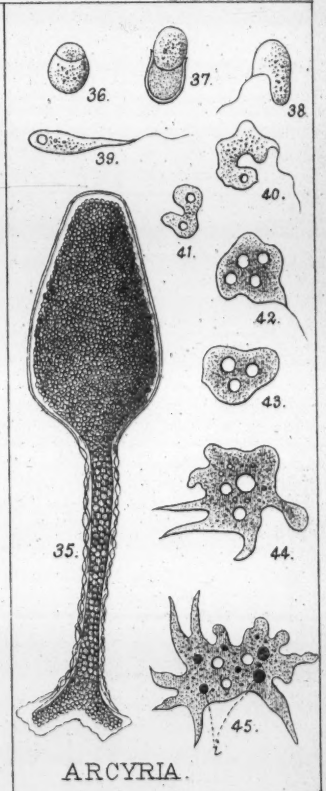
LETTERS FROM A CAT. Published by her Mistress, for the Benefit of all Cats and the Amusement of Little Children. Illustrated with numerous Woodcuts. Small 4to. cloth, gilt edges, 5*s.*



(FULIGO = ÆTHALIUM)



LYCOGALA.



ARCYRIA.

W. Saville Kent del. W. Rhein sc. Mintern Bros imp.

MYCETOZOA.

THE MYXOMYCETES OR MYCETOZOA; ANIMALS OR PLANTS?

By W. SAVILLE KENT, F.L.S., F.Z.S., F.R.M.S.

[Plates III. and IV.]

ALONG the lower confines of the organic world diverse group-forms are to be encountered, of which it is hard to predicate whether they rightly appertain to the animal or to the vegetable series. Prior to that deeper insight into the mysteries of Nature that, thanks chiefly to the improvements made in the compound microscope, has fallen to the lot of the present generation, organisms of even large appreciable dimensions—such as Sponges, Corals, and Zoophytes—furnished subjects of contention between Zoologists and Botanists. Before the rapid advance of modern science, however, the lists for controversy have been gradually growing more and more confined, further progress at the same ratio threatening ere long to place the biologist in the position of the classic hero, who wept for the want of other worlds to conquer. Already, the cordon drawn around the once extensive tourney-ground includes only the lower groups pertaining to Cryptogamic Botany and to that subdivision of the animal kingdom most usually defined by the title of the Protozoa, but which might, with equal consisteney, be designated the department of Cryptogamic Zoology.

All of these agree with one another, and at the same time differ from the more highly organized groups of Phanerogamic plants and Metazoic animals respectively in the obscure and comparatively rudimentary character of their reproductive phenomena.

In recognition of the extreme difficulty that attends the precise definition of an arbitrary boundary line that shall, to the satisfaction of both Botanists and Zoologists, separate the subjects of their respective studies, Biologists have from time to

time proposed the institution of an intermediate kingdom or neutral territory for the reception of all those doubtful organic forms which with more or less justice have been shifted from one side to the other of the barrier-line in accordance with the strength of the evidence adduced. Thus, Mons. Bory de St. Vincent originally instituted for the inclusion of such debatable types his *Le Règne Psychodiaire;* and thus Prof. Ernst Häckel, scantily acknowledging, perhaps, Bory's lead, has quite recently substituted in its place, his so-called kingdom of the 'Protista,' which, in accordance with its founder's views, includes the following divisions:—

KINGDOM *Protista*, HÄCKEL.

		Generic type.
Class 1.	Monera	*Protomyxa.*
2.	Lobosa	*Amœba.*
3.	Flagellata	*Euglena.*
4.	Catallacta	*Magosphæra.*
5.	Labyrinthulæ . . .	*Labyrinthula.*
6.	Diatomeæ	*Navicula.*
7.	Myxomycetes . . .	*Æthalium.*
8.	Rhizopoda	*Gromia.*

As already pointed out by the writer in *A Manual of the Infusoria*, Vol. i. p. 44 *et seq.*, October, 1880, the recognition of such a proposed neutral territory or kingdom by no means lessens, but simply enhances, the pre-existing difficulty. For in place of the simple boundary-line that had formerly to be defined between animals and plants it necessitates the definition of two such lines—the one between the Protista and the lower animals, and the other between that group and the lower plants. Furthermore, as demonstrated by the writer in this treatise, there is scarcely one out of the eight class divisions included in this newly proposed kingdom that cannot be relegated with absolute certainty to one or the other of the two older primary divisions. Several of these groups, again, are most artificially constructed. The class Monera is well-nigh obsolete. Formerly proposed by Häckel for the reception chiefly of the Foraminifera and certain Protozoa, including *Bathybius* (?), in which the presence of a nucleus or endoplast had not been detected, a few obscure amœbiform organisms alone remain to sustain its titular reputation. The Lobosa, as a class separate from the ordinary Rhizopoda, cannot be consistently recognized; while the so-called Catallacta, including the single genus *Magosphæra*, may be appropriately likened to a colonial form of such a multiflagellate Infusorium as *Lophomonas*. Taken as a whole, six out of the eight classes enumerated in the foregoing list conform in all essential points with

that formula of organization distinctive of the lowest or Protozoic section of the animal kingdom. Of the two residual groups, that of the Diatomeæ as assuredly belongs to the vegetable series; one only being finally left, of which it may be said that opinions are substantially divided as to their animal or vegetable affinities. It is with this single section, No. 7, or that of the Myxomycetes, that this article purposes to deal.

The Myxomycetes, Myxogastres, or Mycetozoa, as they have been variously designated, have up to a very recent date remained undisturbed within the precincts of the vegetable kingdom, being accepted on all hands as constituting a subordinate, though somewhat abnormal group of the Gasteromycetous Fungi. The diagnosis of the order, as given in M. J. Berkeley's *Introduction to Cryptogamic Botany*, 1857, and reproduced in other English text-books of Mycology, runs as follows:—

'*Whole plant at first gelatinous. Mycelium often vein-like, forming reticulated or anastomosing strata, but sometimes diffuse, giving rise to sessile or stipitate, free or confluent peridia, consisting of one or more membranes, enclosing, when mature, a dry mass of threads or plates, and spores; at length often bursting. Threads of various structure, sometimes containing one or more spirals.*'

Mr. Berkeley further proceeds to say (l.c. p. 336),—'This is, perhaps, one of the most remarkable groups of Fungi, and at present one on which we have least information. In their early stage they consist of a pulpy or cream-like mass, collected in distinct globules, or creeping over its matrix in the form of branched anastomosing veins. In this stage the tissues are so delicate that they exhibit no structure, and if hardened with alcohol give no further information. From their great fragility when fully grown, and the free dispersion of their dust-like spores, they are with difficulty preserved in an herbarium. But no Fungi afford more elegance of form or singularity of structure according to the nature of the peridium, the flocci, and the disposition of the spores, which are their three main elements. The beauty of form of their peridia is often combined with exquisite colouring, which is sometimes brilliantly metallic, exhibiting tints of steel, gold, copper, or silver, most nearly resembling in this respect very thin membranes met with in the animal kingdom, such as those of the eggs of certain moths. One form, *Æthalium septicum*, is the pest of hothouses, while a species of *Licea*, *L. perreptans*, sometimes increases with such rapidity in cucumber and melon-frames, as to seriously interfere with the culture of these fruits. One marked peculiarity of the Myxomycetes is represented by their indifference as to the matrix upon which they grow. The same species may occur on plants of the most distant natural affinities, and on

other matrices. One species was observed by Schweinitz to be developed on iron which had been heated in a forge only a few hours previously. Mr. McIver found one on a leaden tank, while Mr. James Sowerby discovered another on cinders in the outer gallery of St. Paul's Cathedral. Like Algæ they appear to derive their nutriment from the surrounding medium, and not from the matrix to which they are attached.'

The data embodied in the foregoing and earlier accounts of the Myxomycetes were held to demonstrate their rightful position to be among the Gasteromycetous Fungi, their apparent nearest allies being the Trichogasters or Puffballs, *Lycoperdon*, *Bovista*, &c., from which, however, they essentially differed in the production of their peridia, or sporangia, from a structureless, pulpy mass instead of from a distinct cellular hymenium. (Illustrations of the fungus-like, matured peridia or spore-receptacles of various typical representatives of the Myxomycetes, natural size and magnified, will be found in the accompanying Plates III., figs. 1, 21, and 35, and IV., figs. 1, 24, and 30 to 32.) So far, the developmental phenomena of these singular organisms—which among both animals and plants are now universally recognized as furnishing the true key to their natural position and affinities—had remained undiscovered, or involved in the greatest obscurity. About the year 1859, however, Dr. A. De Bary, the accomplished Professor of Botany at Freiberg University, applying himself to the solution of this moot question, arrived at some totally unexpected results. The spores on careful cultivation were found to give rise, not to jointed cellular hyphæ, or mycelia, as obtains among all ordinary Fungi, but to flagellate monadiform germs possessing active locomotive faculties, a spheroidal nucleus or endoplast, one or more contractile vacuoles, and the faculty of ingesting solid food-substances. After a short interval these germs, retracting their flagella, assumed an amœboid repent phase and coalescing freely with their neighbours, built up the so-called gelatinous, or pulpy masses, out of which the sporangia, or peridia, were developed. With relation to the phenomena exhibited by the Myxomycetes during their active vegetative life, De Bary arrived at the conclusion that they could not be consistently retained as vegetable organisms, but were referable to the lower animal series, or Protozoic sub-kingdom, and might be more conveniently designated the 'Mycetozoa.'

In the year 1862, the main results arrived at by De Bary were confirmed by L. Cienkowski,* who now for the first time definitely associated with the so-called pulpy mass, derived through the coalescence of the monadiform germs, the title of

* *Zur Entwickelungs-geschichte der Myxomyceten, in Pringsheims Jahrbücher für wissenschaftliche Botanik.* Berlin, 1862.

the 'plasmodium.' This plasmodium, taking the form of either a colossal Amœba, or other Rhizopod, in addition to possessing locomotive faculties and the capacity of ingesting solid food, he further showed to exhibit, in its more extended, ramified condition, a distinct circulation or cyclosis of its internal granular elements. Embodying the results of Cienkowski's investigations with those of his own earlier and more recent researches, De Bary published, in the year 1864, his more extensive account of the Mycetozoa,* which up to the present date is accepted as representing the most complete record extant of the life phenomena of these remarkable organisms. While still included among the Fungi, perhaps for convenience sake, by systematic botanists, their exceedingly anomalous plan of structure and development has in most instances been fully recognized. No more fitting illustration of the estimate accorded to them by this class of biologists is perhaps to be found than the general account of the group included in Julius Sachs' *Textbook of Botany*,† herewith reproduced *in extenso* :—

'The Myxomycetes include a numerous group of organisms which in many respects differ widely from all other vegetable structures, but in the mode of formation of their spores stand nearest to the Fungi, on which account we may treat them as a supplement to that class. The Myxomycetes are remarkable in no ordinary degree from the fact that during the period of their vegetation and assimilation of food they do not form cells or tissues. The protoplasm, which in all other plants is also the general motive power of the phenomena of life, remains in them during the whole of this period perfectly free, collects into considerable masses, and assumes various shapes from the internal force residing in it without becoming divided into small portions which surround themselves with cell-walls, or become cells. It is only when the protoplasm passes into a condition of rest in consequence of being surrounded by unfavourable conditions, or when it concludes its period of vegetation by the formation of the reproductive organs—its internal and external movements ceasing at the same time—that it breaks up into small portions which surround themselves with cell-walls, and which even then never form a tissue in the proper sense of the term. The Myxomycetes live upon decaying and rotting vegetable substances. While endowed with motion, they either creep over the surface of the substratum or live in hollows and pores in its interior, but for the purpose of reproduction they always come to the surface. When entering on the repro-

* *Die Mycetozoen ein Beitrag zur Kenntniss der niedersten Organismen.* Leipzig, 1864.

† English edition, translated by A. W. Bennett and W. T. Dyer. London. 1875.

ductive condition, the entire protoplasmic substance, plasmodium, becomes transformed into sporangia or larger receptacles. In *Æthalium septicum*, the so-called "flowers of tan," this spore-receptacle is represented by a cake-like mass, not unfrequently measuring a foot in length and breadth and over an inch in thickness. The inside of the cake is dark-grey, easily pulverized, and penetrated by yellow veins consisting of tubes interwoven in all directions. The skin, or cortex, consists of densely interwoven, irregular bundles of tubes connected in a peculiar manner, and containing an immense number of calcareous grains as well as a yellow pigment. *Æthalium*, in its plasmodium condition, is able to creep away from the tan upon which it was originally growing, and, climbing up neighbouring plants to the height of several feet, accumulates upon their leaves. The monadiform germs developed from the spores are, under unfavourable circumstances, transformed into microcysts; when dry they remain in this state for months, reverting again to the mobile form when placed in water. The young plasmodia are also capable, under like conditions, of forming cysts out of which they again creep on the return of warm, moist weather. The more matured plasmodia may likewise enter upon a temporary state of rest,—sclerotium. First drawing in its arms or outlying ramifications, it next assumes a sieve-like contour or becomes resolved into a mass of irregular nodules, and the whole substance breaks up into a large number of round or polyhedral cells. When placed in water, the cell-walls again become absorbed, and the sclerotium reverts to the condition of a mobile plasmodium. Finally, the plasmodium having attained its full growth, a fine membrane, or pellicle, is formed over its surface and the interlacing capillitium and spores within, the lime contained within the plasmodium being deposited in the form of granules on the capillitium or wall of the sporangium. The passage to this reproductive phase is accomplished with great rapidity,—two hours only being quite sufficient, in the case of *Æthalium*, to convert a soft mobile plasmodium into the motionless, cake-like sporangium. The water previously contained in the plasmodium is partly expelled in the fluid state, while the residue speedily evaporates.'

Upon the data included in the foregoing epitomization of the structure and life history of the Myxomycetes, and more especially with regard to those that relate to their earlier locomotive and ingestive faculties, it is not to be wondered at that many biologists have come to look upon their association with vegetable organisms as no longer tenable, and to decide that their nearest allies are to be sought for among the animal series. Such an opinion was freely expressed by Prof. Allman in his

Presidential address, chiefly relating to lower organisms, delivered to the meeting of the British Association for the year 1879. Others, taking an intermediate view of the question, have contented themselves with allotting this group a half-way position in the organic chain, Prof. Häckel, as previously notified, incorporating the Myxomycetes in his newly-established kingdom of the Protista, while Prof. Huxley* remarks of their flagelliferous monadiform germs that 'they are embryonic forms of organisms which appear to be as much animals as plants; inasmuch as in one condition they take in solid nutriment, and in another have the special morphological, if not physiological, peculiarities of plants.'

Being greatly impressed in favour of the evidence adduced in support of their animal affinities, the present writer has, in a general outline of the sub-kingdom Protozoa, included in Part I. of his *Manual of the Infusoria*, thought fit to accept the Myxomycetes, or Mycetozoa, as veritable Protozoa, indicating at the same time the very numerous points in which their structural and developmental phenomena tally with those of the more typical representatives of that zoological series. In this manner it was shown that the initial term or flagelliferous unit developed from the spores of these so-called Fungi—possessing a nucleus, contractile vesicle and capacity to incept solid food particles — is in noways distinguishable from an ordinary representative of the genus Monas, as defined by the writer at p. 232 of the *Manual* quoted. The succeeding or 'plasmodium' phase of these organisms, likened by its describers to a colossal Amœba, is similarly correlated by the writer (l.c. pp. 42 and 192) with *Labyrinthula*, and with the amœbiform masses produced through the coalescence of a greater or less number of primary flagellate zooids, out of which the reproductive gemmules of a sponge-body are built up.† The spore-receptacles, or sporangia, are finally interpreted as corresponding on an extended scale with the ordinary encapsuled or encysted conditions of the typical

* *Anatomy of Invertebrated Animals*, p. 44, ed. 1877.

† An additional type, whose adult structure resembles in a remarkable manner the 'plasmodium' condition of the Mycetozoa, is afforded by the *Biomyxa vagans*, as figured and described by Prof. Leidy in his recently published *Fresh-water Rhizopods of North America*, Washington, 1879. This organism, which inhabits the Sphagnum swamps of New Jersey and Pennsylvania, and may be compared to a shell-less *Gromia*, protrudes lobate extensions, or anastomosing pseudopodia, in every direction, which exhibit a distinct granule circulation, while a greater or less number of contractile vesicles are developed, both upon the surface of the body and along the pseudopodial extensions. The likeness cited as subsisting between these correlated organisms is indeed so great, that Prof. Leidy has some doubts as to whether it represents an immature Mycetozoon or an independent Rhizopod. In one example figured, the central protoplasmic mass is filled with ingested *Closteria*.

Protozoa, and also with the hybernating encystments or so-called 'gemmules,' or 'statoblasts' of *Spongilla*, and other Sponge types. Further affinities with the Sponges — these organisms being accepted as Flagellate Protozoa — were held to be manifested in connexion with the fine net-work of anastomosing fibres or 'capillitium,' singularly resembling the horny rete of the keratose Sponges, which is usually developed within the sporangia of the Myxomycetes, and to which are frequently added crystalline or nodular deposits of lime that may be consistently compared with the calcareous or siliceous, spiculiferous elements of ordinary Sponge forms.

While it was expected that mycologists, pure and simple, would be somewhat loth to relinquish the interesting little group of Myxomycetes into the hands of the zoologists, it was anticipated that the protest against their advocated transfer would have been raised upon a more substantial basis than that lodged by Dr. M. C. Cooke in his Journal of Cryptogamic Botany, 'Grevillea,' for December last. Instead of applying himself to a concise and lucid exposition of those points, which, to his mind, establish, as he expresses it, the 'truly vegetable nature' of the Myxomycetes, Dr. Cooke confines his criticism of the views advocated by the writer to an unsupported contradiction of the facts accepted as indicative of their animal affinities, accompanied by what must be objected to as a direct misrepresentation of the arguments used in the practical application of these facts to the question raised. In the first place, it is affirmed that De Bary has entirely abandoned his former views respecting the animal affinities of the Myxomycetes. Can Dr. Cooke quote any work or paper in which a renunciation of the facts and opinions expressed in his treatise, *Die Mycetozoen*, published in the year 1864, is recorded? This record again being, not as his critic ingeniously affirms, written 'in a hurry and repented at leisure,' but representing the result of many years' careful investigation, backed by the confirmation of all essential facts at the hands of an independent authority. The editor of 'Grevillea' next politely suggests that, in attempting to correlate the Myxomycetes with the Protozoa, the present writer has 'gone out of the way to meddle with a subject that he does not understand,' that he has no practical acquaintance with the organisms of which he treats, and no knowledge of the later important Polish and other works upon the Myxomycetes, which do not support their animal affinities. Finally, Mr. Saville Kent is accredited with an attempt 'to squeeze the Myxomycetes into the animal kingdom by stealth;' and to have done this in defiance of axioms he has elsewhere adopted, for the distinction of the ordinary infusorial types from lower plants, including, more particularly, their capacity to ingest solid food. That the Myxomycetes are en-

dued with a similar ingestive faculty, Dr. M. C. Cooke practically denies.

To the foregoing heavy bill of indictment it is incumbent upon the accused to make some brief response. To the one count, that of having based his arguments in support of the animal nature of the disputed group mainly, if not entirely, on the evidence adduced by De Bary and Cienkowski without having then a practical knowledge of the organisms or their more recent literature, the writer must to some extent plead guilty. Such admission must, however, be qualified by the fact of his having a short while since made himself familiar with both the structure and developmental phenomena of various ordinary fungi under able guidance at the South Kensington Biological Laboratory, so that he was not altogether meddling with an unknown subject in pronouncing an opinion upon the claims of the Myxomycetes for association with these Cryptogams. Neither respecting more recent literature can the writer acknowledge himself to have been entirely in the dark. As a subscriber to that work, he possessed, and had referred for further information, to Dr. M. C. Cooke's *Handbook to British Fungi*, Vols. I. and II., published in the year 1871, and in which he confidently anticipated finding a masterly, *ex-cathedrâ* summary of all that was known concerning the structure and vital phenomena of the Myxomycetan order, with a special reference to the investigations of Continental mycologists. The distinguished compiler of the *British Handbook* had, no doubt, worked out the problem for himself, and had important affirmative or negative evidence to submit. Alas, for such hopes! Trace of original investigation there was none, while the latest literature of the subject with which the editor displayed familiarity was Berkeley's *Outline of an Introduction to Cryptogamic Botany*, quoted over leaf, and written fourteen years before (1857). His diagnoses and more general descriptions of the characters of not only the Myxomycetes, but also of the Hymenomycetes, Gasteromycetes, Coniomycetes, and Hyphomycetes, with those of their leading secondary subdivisions are admittedly copied word for word from that source. The results of the writer's well-intentioned efforts in pursuit of knowledge, so far therefore as they related to the *Handbook of the British Fungi*, have to be registered a blank. The serial that enshrines Dr. Cooke's indignant repudiation of the writer's furtive attempts to rob mycologists of one of their most interesting orders kindled hope anew. Though silent as the Sphinx concerning the titles of the newer important works, that if consulted would have convinced the writer of the error of his ways, the editor of 'Grevillea' produces on the cover of his journal a list of his voluminous contributions to Cryptogamic literature, including

one bearing the title of 'the Myxomycetes of Great Britain. London, 1877.' Here, at length, was a 'Daniel come to judgment;' here, doubtless, were to be found revealed developmental facts and features undreamt of in the philosophy of De Bary and Cienkowski, and by which the writer was to find that the views he advocated respecting the animal nature of these organisms were utterly demolished. The book in question, however, as advertised in 'Grevillea,' hardly fulfils the promise of its title. In place of an original treatise, representing the outcome of many years' original research on the part of Dr. Cooke, it proved to be a mutilated transcript only of a 'monograph of the Mycetozoa,' published by Rostafinski, in Polish, in the year 1875. As the author naïvely admits on the title-page, 'the characters of all the orders, families, and genera, with descriptions of the British species and original analytical tables,' are reproduced word for word from the Continental work; and since 'the Myxomycetes of Great Britain' consists exclusively of these translated characters, with two or three pages of editorial introduction, its claim to recognition as an independent treatise as announced in 'Grevillea,' is somewhat doubtful. As a translation, limited only to the diagnoses of the British representatives of the group, it furthermore does but imperfect justice to the more comprehensive system embodied in Rostafinski's Monograph; and it is therefore satisfactory to know that a complete translation of this work from the Polish into the German language is shortly announced.

Thus much for the external features of the 'Myxomycetes of Great Britain,' but what of the internal ones? Instead of producing, as the writer anticipated, a complete refutation of De Bary's and Cienkowski's observations, Rostafinski not only embodies in his diagnosis of the group the characters of the several developmental stages made known by these two authorities, but also in many instances reproduces their figures in conjunction with his own, and even adopts De Bary's title, 'Mycetozoa,' in preference to that of Myxomycetes, for the distinction of the group. It needs indeed but to reproduce Dr. Cooke's translation of Rostafinski's diagnosis of the order, as given below, to demonstrate this point:—

'MYCETOZOA. De Bary, 1861; Rostafinski, 1875.

'When young, naked, mobile, in consequence of which the masses of plasmodium have a changing form. These masses at the time of fructification, sometimes dividing themselves into single parts, are transformed into motionless fruits. Fruit either irregular in form (*plasmodiocarp*) or regular (*sporangium*). Sporangia, through fusion and union, produce, now and then, compound fruits (*Æthalium*). Æthalium usually of considerable dimensions, of regular or irregular form, naked, or covered with a common

coat (cortex). Spores produced within the fruit through free-cell formation, or on the surface through division. The contents of the spores at the time of germination give rise to either at first a naked zoospore provided with a nucleus, a cramped (contractile) vacuole, and long cilia, or to an amœboid. These zoospores, or amœbæ, floating together in masses, give rise to mobile plasmodia.'—*Rstfki. Mon.*, p. 83.

The points conceded in the foregoing diagnosis, viz., the derivation of the sporangia from mobile plasmodia, which are themselves built up through the coalescence of a greater or less number of spore-derived amœboid or flagelliferous units, which are provided with contractile vesicles, and, it should be added, the faculty of ingesting solid food, furnish all that the writer requires for the establishment of their animal nature and affinities. Rostafinski's systematic monograph, at the same time, deals almost exclusively with the histology and specific distinctions of the sporangia and their contained elements, no data or drawings of their developmental phases being included, beyond such as are evidently derived second-hand from De Bary and Cienkowski. The editor of 'Grevillea' ignoring the facts adduced by these authorities, denies that the Myxomycetes subsist on solid food matter, and has possibly a revelation of his own to disclose. Can it be that he gives adhesion to a novel interpretation of the development of the group placed on record by a Mr. George Massie in the pages of *Science Gossip* for January 1881, and in which the Mycetozoon *Spumaria alba* is represented as producing spores, which give rise to jointed hyphæ, after the manner of the typical Fungi? A submission of the drawings of these germinating spores to a mycological expert, resulted, as was anticipated, in the verdict that they had nothing whatever to do with the species to which they were accredited, but represented the adventitious spores of a species of *Penicillium*, most probably *P. crustaceum*. Mr. Massie treats the account given by De Bary and Cienkowski of the spores giving exit to motile monadiform or amoeba-like germs as an idle tale, unsupported by correlation with any recognized specific form, and which must vanish into thin air before the weighty proofs adduced through his own original investigation of *Spumaria alba*. The spores of *Fuligo varians* (*Æthalium septicum*) are also referred to by this writer as giving origin to branching threads, though, unfortunately, the further development of it 'was not observed.' Other nameless species are likewise reported by Mr. Massie to have exhibited a similar plan of germination, while not in a single instance out of a number of types experimented upon were mobile cells observed to originate directly from a spore.

That Mr. Massie is totally unacquainted with the original records of De Bary and Cienkowski is evident from the fact,

that in making a quotation from the general account of the Ontogeny of the Mycetozoa, as elicited by De Bary, delivered by Prof. Allman to the British Association meeting in the year 1869, he remarks: 'It is much to be regretted that the Professor should not mention the species presenting such unusual and interesting phenomena.' Had Mr. Massie consulted the two authorities cited, he would have discovered that the developmental phenomena referred to were traced in connexion with no less than twelve well-known species, a list of which is herewith given:—

Didymium Libertianum, De Bary = *Chondrioderma difforme*, Rtfki.
Stemonitis obtusata, Fr. = *Comatricha Friesiana*, Rtfki.
Stemonitis fusca, Roth.
Æthalium septicum, Fr. = *Fuligo varians*, Somm.
Enerthenema papillata, Bourn.
Arcyria punicea, Pers.
Trichia varia, Pers.
Lycogala epidendron, Fr.
Didymium serpula, Fr.
Didymium leucopus, Fr. = *Physarum leucopus*, Rtfki.
Physarum album, Fr. = *Condrioderma difforme*, Rtfki.
Licea pannorum, Wallroth.

In the two plates accompanying this article, the writer has further reproduced from the voluminous drawings of MM. De Bary and Cienkowski, their most characteristic illustrations of the developmental phases of some half-a-dozen of the above-named species; in all of which it is clearly shown that the spores give birth to monadiform germs, out of which, through further development and coalescence, the repent amœbiform plasmodia, and subsequently the fungus-like sporangia, are constructed.

Finally, since the Editor of 'Grevillea' has determined to repudiate this testimony, he declares that in order to establish the animal nature of the Myxomycetes, it is requisite to produce evidence of a more substantial kind than the mere citation of De Bary and Cienkowski, suggesting in a previous paragraph that the present writer has no practical acquaintance with the organisms under discussion, but has simply 'based his theory upon the figures he has observed in illustrated books.' Unfortunately for this intended overwhelming argument, it happens that even previous to the publication of his views in favour of their zoological affinities, the writer was by no means unacquainted with representatives of this interesting group. Examples of *Craterium pyriforme* (named by Dr. Cooke) and *Badhamia inaurata*, collected some time since and lately examined, assisted him to arrive at the opinion submitted. This examination, admittedly, was restricted to the matured Sporangia and their component elements, the

developmental phenomena being recorded, as duly acknowledged, on the strength only of the two Continental authorities. More recently, however, recognizing that greater satisfaction would be derived from a personal investigation of these developmental data, a variety of species have been carefully cultivated with the most substantial results. In addition to the two species above named, the writer has been supplied by Mr. Thomas Brittain, a well-known mycologist of the Manchester district, with authentic examples of *Lycogala epidendron*, *Stemonitis fusca*, *Diachæa elegans*, and *Physarum tussilaginis*. Spores of all were sown in distilled water on ordinary slides, covered with thin glass, and kept, when not under direct examination, in a moist chamber. These were now examined from day to day and hour by hour. In some instances, where the spores had been preserved for too long an interval, germination failed, but in other cases, notably *Badhamia inaurata*, *Stemonitis fusca*, and *Physarum tussilaginis*, an interval of from three or four days to a week has sufficed for the rewaking of their latent vitality and the liberation of the contained germs. These germs in every instance agreed substantially with the figures and descriptions given by De Bary and Cienkowski,—the one form, *Stemonitis fusca*, illustrating a type examined by the first-named writer, while the two others represent species of which the developmental phases have not been previously described.

The phenomena exhibited, as observed by the present writer, while in all cases identical, may be preferentially recorded of *Physarum tussilaginis*, illustrated by the accompanying Pl. IV., figs. 30 to 55. In this species the spores being of large relative size,—1 – 2000″ to 1 – 1500″, those of the other forms averaging but little more than one half these dimensions,—are admirably adapted for cultivation. The power chiefly employed in their more minute examination was a $\frac{1}{16}$th inch objective by Gundlach, with a magnification of from 600 to 1200 diameters; a lower power, $\frac{1}{4}$ inch, sufficing for taking a more general numerical survey. So soon as within seven hours after wetting the spores, or indeed directly following their deposition on the slide, an examination revealed the companionship of innumerable *Bacteria*, at present quiescent, with a more or less abundant sprinkling of spores other than those of *Physarum*, and of considerably smaller size. The presence of these adventitious elements immediately, and not unnecessarily, suggested the desirability of precaution in the registration of subsequent events. The spores specially sown were found, under high magnification, to consist of an outer wall of considerable thickness, finely echinulate externally, and exhibiting, by transmitted light, a dark amber or chitinous coloration. The protoplasmic contents rarely entirely filled the

outer shell, but remained separated from it by a greater or less number of angular interstices. A central spheroidal nucleus, with a contained nucleolus, one or more large refringent corpuscles, and numerous smaller granules, represented the sum-total of the recognizable internal elements. By the end of the second day active life had already dawned upon the scene. Bacteria were swiftly propelling themselves to and fro in all directions; one or two biflagellate monads, *Heteromitæ*, whose development was subsequently traced from certain of the smaller spores above mentioned, glided slowly along, dragging their posterior flagella, 'gubernacula,' cablewise behind them; then presently a turn of the stage adjustment brought the observer face to face with a germinating spore, having a slender thread-like hypha. Robinson Crusoe's feelings, when stumbling upon the naked footprint on the sand, frequently imagined, were momentarily realized. Were De Bary and Cienkowski in the wrong? Had they mistaken some of these *Heteromitæ*, or other intruding monads, for Myxomycetan germs? and did this interesting little group after all develope after the manner of a common Fungus? A little more patience, and the spore from which the hypha emanated was discovered to be entirely distinct from those of the *Physarum*, and the barometer of our hopes was once more in the ascendant. Sparsely scattered amongst the spores of the Myxomycetan were presently observed, isolated hyaline protoplasmic spheres having the same diameter and structure as the contents of the spore-cases, just described. In a little while the exit of one of these hyaline spheres from the echinulate spore-cases was witnessed, and the relationship between the two substantially established.

By the termination of the third day, these protoplasmic spheres had much increased in number, some of them exhibiting feeble amœboid movements. An additional factor had, however, now appeared upon the scene in the form of a vermicular monadiform organism (Pl. IV., figs. 49 and 50), having a length of 1–1250″ to 1–1000″, and which progressed somewhat clumsily through the water revolving on its longitudinal axis. A spheroidal nucleus, with its enclosed nucleolus, was observable towards the anterior extremity, and a single rhythmically contracting vesicle at the opposite region of the body. The derivation of these monadiform beings, from the extruded protoplasmic spheres, was immediately suspected, and the correctness of this inference soon substantiated. Selecting an isolated and recently-extruded sphere, it was carefully watched; and within a space of two hours the entire transformation was gradually accomplished

For a considerable interval the newly released germ confined its signs of vitality to a feeble expansion and contraction of its peripheral margin, and to the rhythmical pulsations of its con-

tractile vesicle, which, as well as the spheroidal endoplast, was clearly discernible. As time progressed, alterations in contour were more strongly manifested, though without the germ moving away from the scene of its birth. At length an altogether elongate amœboid, or vermiform aspect predominated, the nucleus or endoplast being shifted to one extremity and the contractile vesicle occupying the other. Then all at once, a flickering at the end containing the nucleus indicated the development of a flagellate appendage, which in a few seconds became distinctly visible. The vibratile motion of this organ soon caused the body to oscillate and presently lifted it from its hitherto prone position. It now remained adherent only by its posterior extremity, and, in a few more seconds, was launched into the surrounding water a free-swimming, elongate monad. The several successive phases just described will be found illustrated in Pl. IV. by the figures numbered consecutively 43 to 48. During the next few days, similar monadiform germs were developed abundantly from the spores in all parts of the field, and the next step in their ontogeny fully certified. It was found in fact that the free-swimming condition of the germs was but of brief duration, and subservient, apparently, only to their local distribution. Within a day or two, sooner or later, the monadiform beings once more betook themselves to a repent mode of existence, the flagella being for a while retained, communicating to them a remarkable likeness to the repent flagelliferous animalcules, for which F. E. Schulze has proposed the generic title of *Mastigamœba*. The flagella being completely withdrawn, the organisms were now undistinguishable from ordinary *Amœbæ*, and continued to creep about the field by broad, ovate expansions of their periphery, after the manner of those Rhizopods.

An important point yet remained to be solved. De Bary and Cienkowski had declared that during both their monadiform and subsequent amœboid phases, the Myxomycetes ingested and subsisted on solid food matter, figures as given by them in illustration of such nutritive faculties being reproduced in Pl. III., figs. 15, 16 and 45, and Pl. IV., figs. 12, 13 and 28. This evidence has been regarded by some writers as extremely doubtful, while by others it has been categorically denied. A simple experiment, however, soon demonstrated that these two authorities were again completely in the right. Examples, more especially of the repent amœboid units, had been previously observed, whose bodies contained vacuoles more or less completely filled with ingested *Bacteria*, which, being produced in numbers prior to the hatching out of the *Physarum* germs, provided for the Mycetozoa an abundant and ready set feast. The common test of adding pulverized carmine to the water, of such value in

determining the ingestive faculties of ordinary Infusoria, was speedily followed by its free inception by both the natatory monads and the repent amœbiform units, neither possessing a distinct mouth, but the former taking in the particles chiefly towards the anterior region of the body, and the latter indifferently at any point of the periphery. As in the case of *Bacteria*, the smaller particles of pigmentary matter, after inception, were usually collected together within spheroidal vacuoles of the endoplasmic region, and maintained therein the same molecular movements they exhibited in their free condition. The larger particles, on the other hand, remained distributed as more or less distinctly isolated fragments. For the next few days, and indeed up to the time of going to press with this article—ten days or a fortnight after their exclusion from the spores—these amœboid organisms have continued to feed and increase in size, many of them measuring twice their original dimensions, and may be said to be fairly started on their way towards the succeeding chapter in their ontogeny, viz. their production through coalescence of the comparatively colossal but still amœbiform 'plasmodia,' out of which the spore-receptacles or sporangia are finally evolved.

The points now verified, through personal investigation, concerning the development and nutritive phenomena of the Myxomycetes are herewith accepted by the writer as affording the strongest confirmation of his views previously expressed, to the effect that these organisms have nothing whatever to do with Fungi, but are rightly referable to the Protozoic division of the animal series. Among these their correlation may be accomplished with the utmost ease, their entire life-cycle, indeed, being precisely parallel in kind, though differing in degree, with what obtains among the ordinary Flagellate Infusoria. A primary flagelliferous phase, an intermediate repent amœboid condition, and a final encysted sporiferous state, these three, represent the normal life-cycle of a monadiform animalcule.

The only essential distinction manifested on the part of the Myxomycetes and which, as just stated, is only one of degree and not of kind, consists in the fact that the final act, that of encystment, and the resolution of the body into spores, is in this group accomplished by a mass of coalescing or conjugating units, which consequently produce a relatively colossal spore-receptacle or sporangium—the so-called Fungus—while in the case of the typical Flagellata it is an isolated monad, or two or a few conjugated units only, that build up the relatively minute, but otherwise morphologically and physiologically identical reproductive structure. While thus the life-cycle of an ordinary Monad may be declared to be an abbreviated epitomization only of what, when reduced to its

simplest expression, takes place with the Myxogasters, or as they may be preferably designated the Mycetozoa, this last-named group can undoubtedly claim bonds of affinity with other more complex Protozoa. Thus, as previously intimated, the horny rete or capillitium mostly, but not always, developed within the sporangium of the Mycetozoa, singularly resembles the horny network or skeletal elements of the keratose sponges; while the calcareous concretions also frequently, but not invariably, developed in intimate connexion with the capillitium and wall of the sporangium, may be similarly compared with the mineral concretions or spicula of the sponges. As certain sponges occur that possess neither a horny rete nor spicula, so Mycetozoa are also to be found having no mineral concretions, and in which the capillitium is either absent or altogether rudimentary, demonstrating alike in either instance the non-essentiality of these several elements. A case in point illustrative of the resemblance that subsists between sponge spicules and the mineral concretions of the so-called Fungi is afforded by the species of *Physarum*, whose developmental phenomena have just been recounted, and in which, as shown at Pl. IV., fig. 35, the minute stellate calcareous bodies scattered over the outer wall of the sporangium, are directly comparable with the minute stellate spicula characteristic of the Sponge group distinguished by the title of the Tethyidæ.* In yet another direction the two groups of the Mycetozoa and Spongida may be co-ordinated. The sporangia or spore-receptacles of the first-named class, representing the quiescent state entered upon as the closing act of vegetative life, while morphologically comparable with the encysted phases of the ordinary Flagellate Infusoria, may, in virtue of their essentially compound character, be more correctly identified with the spicule-invested, compound, hibernating encystments or statoblasts (Carter), into which many sponge forms, including *Spongilla*, become resolved on the termination of the season's growth, and out of which are again liberated the flagelliferous elements that build up anew compound sponge-stocks.

In conclusion. With those mycologists to whom every spore-capsule is necessarily a Fungus, and whose vision is sealed to every organism beyond their special line of research, the group of the Myxomycetes or Mycetozoa, will doubtless to the end of

* It has been maintained by some advocates of the vegetable nature of the Myxomycetes, that these spicule-like structures differ in no way from the crystalline secretions of many plant-tissues known as 'rhaphides.' The unsoundness of such an interpretation is however made obvious in connexion with the fact that plant rhaphides are essentially *intra*-cellular secretions, while the spicular elements of both the Sponges and Mycetozoa are as strictly *extra*-cellular developments.

time be Fungi still. Embryological, developmental, and even structural data, are with these taxonomists of no account; a receptacle containing spores, never mind whence derived, and no matter what it produces, constitutes with them the *ne plus ultra* of what they are pleased to term a Fungus. With the intelligent biologist, however, who approaches the question, familiar with the fundamental structural, and developmental phenomena of other lower organic groups, and who is qualified accordingly to strike a just balance in accordance with the evidence, it is herewith predicated that the days in which these organisms shall be accounted Fungi, or even vegetable types, are already numbered. Every successive stage in their life-history, from their first exit from the spore until their final resolution into similar reproductive bodies, may be consistently correlated with those of the typical Protozoa, and with them alone. With the Fungi, on the other hand, their likeness, as manifested only in the matured spore-receptacle, is altogether superficial and illusory. In the pages of 'Grevillea' the writer has been accused of an attempt 'to squeeze the Myxomycetes into the animal kingdom by stealth.' The present article constitutes in itself, perhaps, the fullest refutation of this charge. The stronger and more intense the light from all sides concentrated upon the question at issue the better. Above all things, moreover, let the light be reflected on the subject by means of the mirrors and condensers of our compound microscopes. Let each for himself work out the simple morphological and developmental data that must ultimately decide the point. But before all things let the subject be approached by those possessing so sufficient a practical acquaintance with all cognate organisms as shall forewarn and forearm them against the innumerable pitfalls that will otherwise encompass them on every side.

EXPLANATION OF PLATE III.

The letters n. and c. v. have the same meaning throughout, signifying, respectively, the nucleus or endoplast, and the contractile vesicle.

Figs. 1–20. *Æthalium septicum*, Fries. *Fuligo varians*, Somm. (*after De Bary*).

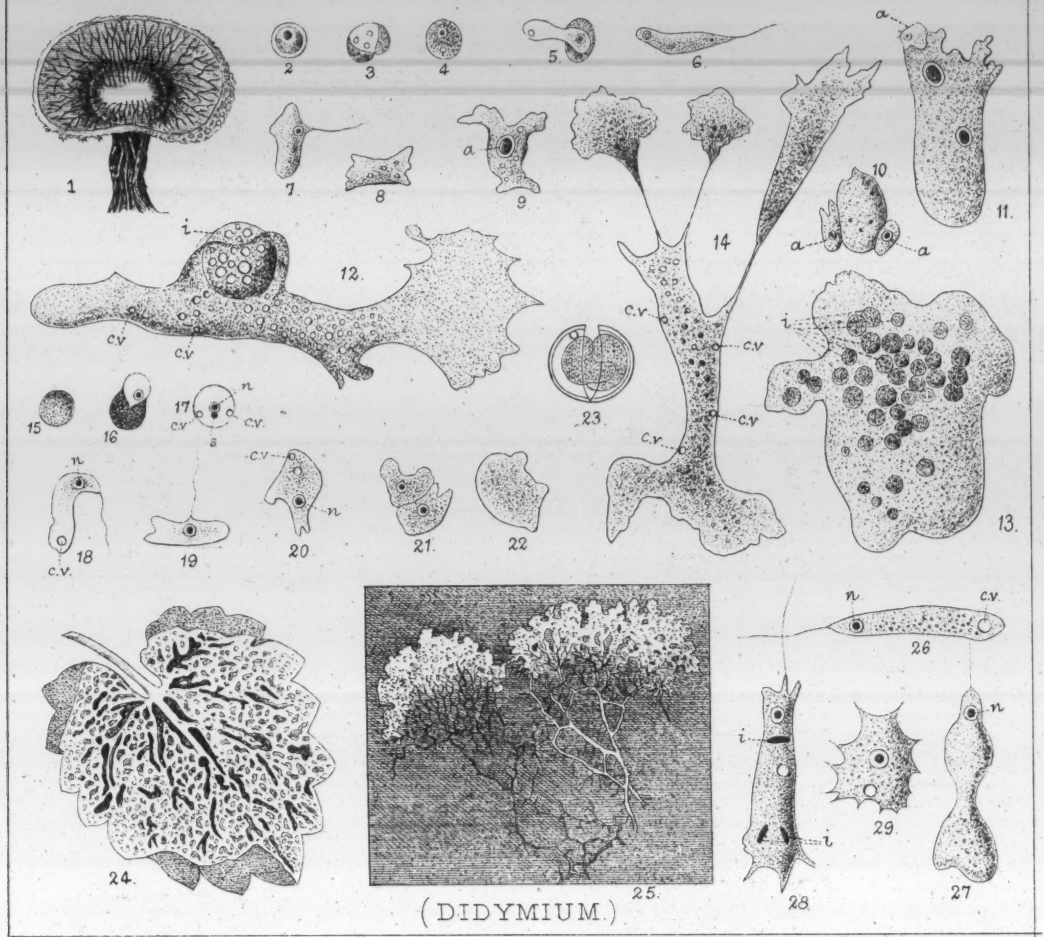
Fig. 1. Portion of margin of ripe sporangium showing crust-like outer wall and internal spore mass, natural size.

Fig. 2. Fragment of internal, horny network, or 'capillitium,' × 390.

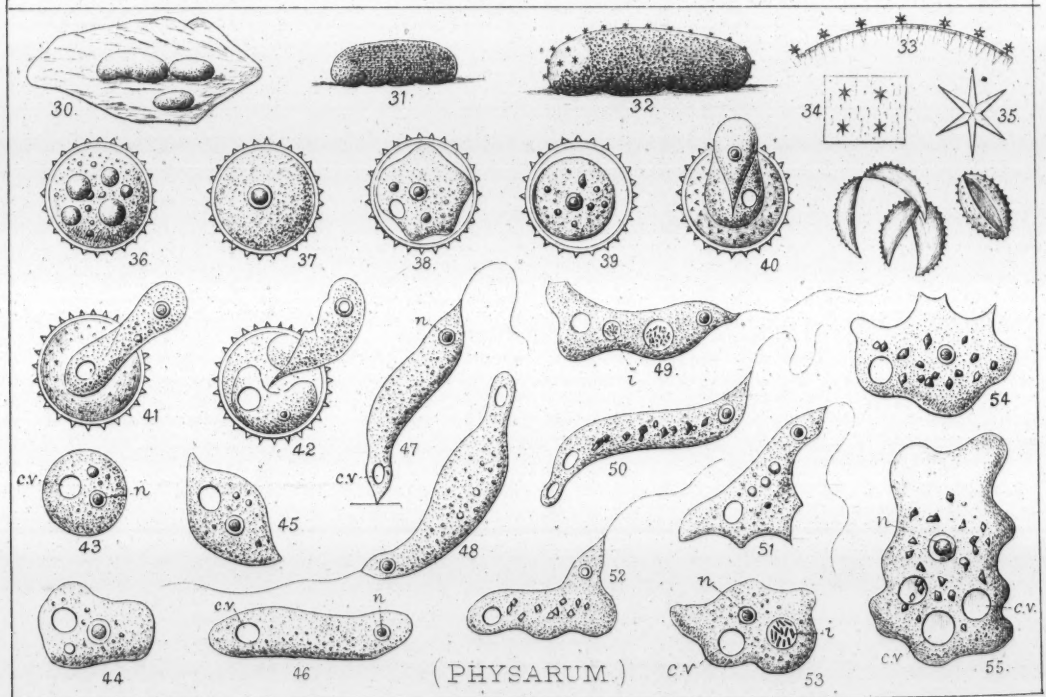
Fig. 3. Three isolated spores, × 390.

Figs. 4–7. Amœbiform germs being liberated through the rupture of the spore-wall; that at 7 entirely free, × 390.

Figs. 8–11. Successive flagelliferous or monadiform phases of the same germs.



(DIDYMIUM.)



(PHYSARUM.)

W. Saville Kent. del. W. Rhein sc.

Mintern Bros. imp.

MYCETOZOA.

FIGS. 12–14. More advanced germs which have again assumed the repent amœboid state, × 390.

FIG. 15. A small repent 'plasmodium,' produced through the further development and continuance of a number of the preceding amœboid units; at *i*, ingested food substances, × 390.

FIGS. 16, 17. Encysted plasmodia; the one at 16 containing numerous ingested *Æthalium* spores, × 200.

FIG. 18. Young repent plasmodium, with fine, hair-like pseudopodia developed posteriorly, × 390.

FIG. 19. A ramifying plasmodium extended on a glass slide; natural size.

FIG. 20. Fragment of the same plasmodium, × 45.

Figs. 21–34. *Lycogala epidendron*, Fries. (*after De Bary*).

FIG. 21. Two matured sporangia attached to tan-wood, natural size.

FIG. 22. A mature sporangium in perpendicular section, showing disposition of capillitium, × 10.

FIGS. 23–30. Successive developmental phases from the spore through the flagelliferous stage, until at 29 and 30 the condition of young repent plasmodia is arrived at, × 390.

FIGS. 31–34. More matured plasmodia, that at 32 exposed to view through making a section of tan-wood, × 390.

Fig. 35. *Arcyria cinerea*, Fries.
Figs. 36–45. *Arcyria Punicea*, Pers. (*after De Bary*).

FIG. 35. Matured sporangium, × 30.

FIGS. 36–45. Developmental phases from the germination of the spores through a monadiform condition to the repent plasmodium state; the example at 45 with *i*, ingested food particles, × 390.

EXPLANATION OF PLATE IV.

Figs. 1–14. *Didymium Libertianum*, De Bary (*after De Bary.* 2–14, *after Cienkowski*).

FIG. 1. Matured sporangium in longitudinal section, showing capillitium, × 25.

FIGS. 2–9. Developmental phases from the germination of the spore to the condition of small repent plasmodia, × 350.

FIGS. 10 and 11. Small repent plasmodia increasing their dimensions through coalescence with the more minute amœbiform units *a a a*, × 350.

FIGS. 12 to 14. More matured plasmodia, that at 12 in the act of engulphing a large food corpuscle, *i*, and that at 13 filled with similarly ingested corpuscles, the attenuatedly extended plasmodium at 14 with four laterally developed contractile vesicles, × 350.

FIGS. 15 to 22. Similar developmental phases of *Didymium* (*Physarum*) *album*; at 21 the amœboid units uniting to produce the young plasmodium, fig. 22, × 350.

FIG. 23. Spore containing two germs. (After De Bary.)

Figs. 24–29. *Didymium*, Fries. (*After Cienkowski.*)

FIG. 24. Matured sporangium developed in a reticulate form over a living leaf of ground ivy (*Glechoma hederacea*), natural size.

FIG. 25. Portion of matured erect branching plasmodium. Nat. size.

FIGS. 26–29. Monadiform and amœboid germs, that at 28 with *i i*, ingested food particles, × 550.

Figs. 30–55. *Physarum tussilaginis*, B. and Br. (From the writer's original drawings.)

FIG. 30. Three matured sporangia adherent to a leaf of common coltsfoot. (*Tussilago farfara*), × 5.

FIG. 31. Isolated sporangium, × 10.

FIG. 32. A small sporangium in lateral view; towards the extremity *a*, the spores having escaped, have left bare the thin membranous wall, with its externally scattered calcareous spicula, × 30.

FIG. 33. Margin of membranous wall of sporangium, with on the upper surface equidistantly dispersed spicula, and on the under one delicate branching capillitium threads, × 100.

FIG. 34. Fragment of sporangial membrane with scattered spicula as seen in superficial view, × 100.

FIG. 35. An isolated hexradiate-stellate spiculum from the sporangial membrane, × 400.

FIGS. 36–39. Germinating spores showing different stages of development, × 800.

FIGS. 40–42. Spores with their walls ruptured, giving exit to amœbiform germs; at 42 an abnormal example containing two germs, × 800.

FIGS. 43–48. Successive phases of development of a single extruded germ to a free-swimming monad, as described at page 111, × 800.

FIGS. 49, 50. Two free-swimming monads, in the former one the vacuoles at *i*, contain exceedingly minute injected carmine particles; the example at 50 with larger, and scattered ingested granules of the same pigment, × 800.

FIGS. 51, 52. Monads that have entered upon a repent amœbiform existence, the flagella as yet being retained; the example at 52 with ingested carmine particles, × 800.

FIGS. 53–55. Repent amœbiform zooids, or young plasmodia, representing ulterior developmental phases of the preceding free-swimming monads; the examples 54–55, with numerous ingested carmine particles, × 800.

THE PERMANENCE OF CONTINENTS.

By J. STARKIE GARDNER, F.G.S.

'IT is not too much to say that every spot which is now dry land has been sea at some former period, and every part of the space now covered by the deepest ocean has been land.' This sentence occurs in the latest edition of Lyell's *Principles of Geology*, still perhaps the most authoritative text-book on the subject, and the view it expresses has been generally received as an article of faith by geologists until within a few years, or even months ago.

Lately a change of view has taken place, and now many distinguished men hold the completely opposite opinion that oceans have been permanent from the remotest times, and that continents are, and have ever been, fixed lands, subjected to ceaseless modifications of form. Among the most conspicuous partisans of the new theory are Sir Wyville Thomson, Prof. Geikie, and Mr. Wallace; and the latter especially seems to have collected together and presented in his fascinating book, *Island Life*, every kind of evidence that tends to support it. Nothing appears to have escaped him, yet the whole when summed up must seem to every geologist to fall far short of proof. Still, although the evidence upon which the theory is based is as yet wholly insufficient, it by no means follows that the theory itself is improbable.

The chief evidence upon which the *Permanence of Continents* at present rests, is purely geological. It is argued that the whole of the sedimentary rocks are littoral deposits, or those of inland seas; and if this can be maintained, the theory would, almost as a matter of course, be accepted. Mr. Wallace, therefore, endeavours by every means to prove it.

Chief among deposits hitherto supposed to be oceanic, is the Chalk; and to the discussion of this formation, accordingly, almost a whole chapter is devoted. Mr. Wallace expresses the belief that, far from the Chalk sea representing a wide ocean with a

few scattered islands comparable to some parts of the Pacific, 'it formed as truly a portion of the great northern continent as it does now.'

The evidence, which he has to set aside, in favour of the Chalk being a truly oceanic deposit, is extremely weighty however, and by no means easily disposed of. Its vast extent—stretching from Sweden to Bordeaux, and from Ireland to China—and its freedom everywhere from impurities derived from the degradation of land, are greatly in favour of its oceanic origin. The areas that are known to have been denuded, and the enormous deposits of flint-shingles which characterize the Eocenes from their base upward to the most recent gravels, show how colossal this denudation has been.

The Chalk that has escaped seems but the fragment of a mass which once passed under the Atlantic, for even the Scilly Isles are strewn with flint, and the last remains of it in Devonshire and the north of Ireland are as pure as elsewhere, and show no signs whatever in the Chalk itself, towards its western boundaries, of the proximity of shores. This vast deposit abounds with *Globigerina*, of species identical with those of the modern Atlantic mud, and with coccoliths and discoliths. Representative siliceous Sponges are abundant in both, and the recent chalk-mud has yielded a large number of the group *Porifera vitrea*, which find their nearest representatives among the *Ventriculites* of the White Chalk. The Echinoderms of the deeper parts of the Atlantic basin are very characteristic, and yield an assemblage of forms which represent in a remarkable degree the corresponding group in the White Chalk. Species of the genus *Cidaris* are numerous; some remarkable flexible forms of the Diademidæ seem to approach the *Echinothuria*;* *Rhizocrinus* is closely allied to the chalk *Bourgueticrinus*, while even among fish the genus *Beryx*, so abundant in the Chalk, has been found by Dr. Carpenter, and the fresh light that the publication of the deep-sea fish of the *Challenger* Expedition is likely to throw on the subject will be looked forward to with much interest.

Prof. Duncan,† when investigating Corals, became impressed with the remarkable persistence of character and absence of variability in those of the deep-sea fauna. 'The dredging in 1095 fathoms off the coast of Portugal, which yielded *Pentacrinus Wyville-Thomsoni*, Jeffreys, produced many corals; and the series presented an eminently Cretaceous facies. The genus *Bathycyathus*, whose species, *Sowerbyi*, is so well known in the Upper Greensand, was represented there by numerous specimens of a species closely allied to that form.'

* Sir Wyville Thomson, *Nature*, vol. iii. p. 297.

† *Quart. Jour. Geol. Soc.* xxvii. p. 437.

A new species of *Caryophyllia*, allied by its structural peculiarities to *C. Bowerbanki* of the Gault, and a species identical with the well-known *Caryophyllia cylindracea*, Reuss, sp., were discovered at the same time. The homotaxis of part of the Coral fauna of the Atlantic and that of the Cretaceous ocean, Prof. Duncan considers to be very remarkable.

Against this well-nigh irresistible evidence in favour of the oceanic origin of Chalk, Mr. Wallace states that no specimen of Globigerina ooze yet examined agrees, even approximately, with Chalk in chemical composition. The differences between the few analyses that have been published, are chiefly in the relative quantities of carbonate of lime, silica, alumina, and oxide of iron. It is by no means apparent that Sir W. Thomson's sample is the nearest analogous deposit to Chalk that could be found in the beds of the Atlantic or Pacific; but supposing it to be so, the great changes in chemical composition to which Chalk has been subjected since its consolidation, are entirely overlooked in comparing the analyses.* Chalk is, and probably always has been since its upheaval, constantly saturated with percolating rain-water, which enters as soft water charged with carbonic acid, and comes out in springs of hard water charged with carbonate of lime; and this alone in the course of ages would carry away the more soluble constituents such as iron, alumina, and magnesia. An even more important change is due to the removal by segregation of its silica into the form of flint. This, doubtless, took place when the silica was in a colloid state, and seems to have been arrested, whilst the Chalk was consolidating, wherever harder and softer layers alternate. Its once viscid, almost fluid, state is shown by the manner in which it has penetrated the minutest pores of Echinoderms before destroying the shell; and it seems probable from the way in which it has replaced carbonate of lime,† that it had not parted with its

* The analyses relied upon in support of this are by Sir W. Thomson, of Globigerina ooze, viz.:—

Carbonate of Lime	43·93	to	79·17	per cent.
Carbonate of Magnesia	1·40	to	2·58	„
Alumina and Oxide of Iron	6·00?	to	32·98	„
Silica	4·60	to	11·33	„
Supposed Volcanic Dust	4·60	to	8·33	„

And of Chalk, by David Forbes:—

	Grey Chalk, Folkestone.	White Chalk, Shoreham.
Carbonate of Lime	94·09	98·40
Carbonate of Magnesia	0·31	0·08
Alumina and Phosphoric Acid	a trace	0·42
Chloride of Sodium	1·29	—
Insoluble débris	3·61	1·10

† All the carbonate-of-lime shells are replaced in the Blackdown deposits by silica.

organic acids. That it did not assume the solid state until at least after the partial consolidation of the Chalk is obvious, through the filling in of fissures at right angles to the bedding, which could not have existed when it formed the surface sediment of the ocean bottom. In comparing the White Chalk analysis with that of the ooze, therefore, we must bear in mind that, as already pointed out by Mr. Sorby, Mr. Sollas, and Dr. Wallich, a portion of flint must be added equal to that which has been separated away. In a similar manner, iron has been removed and segregated together, to be crystallized principally into globular balls with a radiating structure.*

The shells composed of carbonate of lime, such as those of Gastropods,† Cephalopods, and Dimyaria, seem also to have been dissolved away, perhaps by the rain-water which falls upon the Chalk, saturates it, and passes through it by capillary action unceasingly. Another evidence of change is shown in the crystalline condition of shells composed of phosphate of lime, such as the Aviculidæ, the Branchiopoda, the Echinodermata, &c.

It is surprising to find that no allusion whatever is made to this range of facts by Mr. Wallace; and those of his readers who are unacquainted with them, are left unaware that Chalk has undergone such great changes in its composition since it was the bed of the sea, as to deprive the unqualified statement that the analyses of Chalk and Globigerina ooze 'do not even approximately agree,' of any scientific value.

These facts further tend to show, as indeed is obvious from a comparison of the faunas, that the similarity in the analysis of the Oahu chalk and the White Chalk, upon which so much stress is laid, is purely superficial.‡ In spite of the fact

* It assumes very beautiful forms in the Grey Chalk, and has occasionally completely replaced Sponges. The iron is frequently ochreous in the White Chalk.

† Gastropods are found as casts in the Grey Chalk, slightly coated with iron, and occasionally traces are met in the Lower White Chalk in the same condition. Higher than this even the most indistinct outlines of the larger forms, such as *Pleurotomaria*, are rare. I have seen but one trace of shell on any spiral Gastropod, and this on a fragment of *Funis* from the White Chalk near Norwich. Small thin fragments adhered to the cast, and the circumstance is remarkable as *Funis* almost alone of the Gastropods preserves its shell in the Cambridge Greensand. The shells of Cephalopods seem to possess a slightly greater resisting power, and their casts are, as a rule, more distinct.

‡ Analysis of Oahu chalk:—

Carbonate of Lime	92·800
Carbonate of Magnesia	2·385
Alumina	0·250
Oxide of Iron	0·543
Silica	0·750
Phosphoric Acid and Fluorine	2·113
Water and loss	1·148

Geology of the U. S. Exploring Expedition, p. 150.

that 'this chalk consists simply of comminuted corals and shells of the reef,' and is, when examined microscopically, 'found to be destitute of the minute organisms abounding in the chalk of England,' Mr. Wallace states that in several growing reefs a similar formation of modern chalk, undistinguishable from the ancient, has been observed.

Mr. Wallace thus assumes that the Chalk is derived from excessively fine mud produced by the decomposition and denudation of coral reefs; but this view appears to me to be untenable. Mr. Murray expressly states that no *Globigerinæ* were found in any of the enclosed seas of the Pacific which possess this chalky bottom; and to account for *Globigerina* in the Chalk it has to be supposed that the Chalk sea was open to the Gulf Stream, *i.e.* the Atlantic. Further, to provide the necessary conditions we are obliged to suppose this vast sea to have been bordered with islands and coral reefs, and that no large rivers flowed into it, and yet absolutely no traces of these coral reefs remain, while an inland sea could hardly have existed in proximity to a great permanent continent without some rivers draining into it. A curious piece of reasoning is that in the Maestricht and Faxoe chalks 'we have a clear indication of the source whence the white calcareous mud was derived which forms the basis of the chalk.' If these local and far newer deposits are seen to be highly coralline and the Chalk is not seen to be so, we have rather a clear indication that they were not deposited under the same conditions. The presence of *Mosasaurus* in the Maestricht beds, and the far newer aspect of its fauna, show that it must have belonged to an altogether different period, probably the one represented in America by a great so-called Cretaceous series containing a mixture of Cretaceous and Tertiary mollusca, dicotyledonous plants, and *Mosasaurus*. From every point of view, in fact, the inference that the vast Cretaceous deposits are analogous to small local deposits of coral mud in the Pacific does not appear to be the true one.

With regard to the probable depth of the ocean which deposited the Chalk, the evidence brought together by Mr. Wallace is less unsatisfactory. Mr. J. Murray, for instance, sees the greatest resemblance to it in mud from depths of less than 1000 fathoms; and Dr. Gwyn Jeffreys finds that all the Mollusca of the Chalk are comparatively shallow-water forms. We must bear in mind, however, that the characteristically deep-sea families and genera, such as *Bulla* and the Solenoconchia, *Leda*, *Neœra*, and *Verticordia*, would have long since been dissolved away if present; while great and highly characteristic cretaceous genera, such as *Inoceramus* and *Hippurites*, are wholly

extinct, and nothing therefore can be safely predicated concerning their habits.

In the Grey Chalk near Folkestone dark impressions of nearly all the deep-sea Mollusca enumerated above are abundant; and the Gault and a part of the Lower Greensand are full of their shells in perfect preservation. Their absence in England at least, from the Chalk, seems very clearly due rather to subsequent destruction than to their never having been present. Of the Chalk genera that are preserved, *Pecten*, *Amussium*, *Lima*, *Spondylus*, *Anomia*, and the Brachiopoda are represented by Dr. Gwyn Jeffreys as having been dredged at from 1450 to 1750 fathoms and upwards. As for the abundance of Ammonites showing, as Dr. S. P. Woodward once supposed, the water to have been as shallow as thirty fathoms, Mr. Wallace himself would be the first to repudiate such mere supposition, were it urged against the theory he seeks to establish. Were *Nautilus* and *Spirula* shallow-water forms they would long since have been captured abundantly. The still existing shells of the Chalk itself are so few that little weight can be attached to them as an indication of depth, but in the lower Cretaceous deposits Mollusca abound, as already stated, and in perfect preservation; and their facies, taken with the complete absence of shallow-water forms, implies, Dr. Gwyn Jeffreys believes, a depth of sea in the Gault period of somewhere about 1000 fathoms. Mr. Sorby, from quite other considerations, believed the Gault to be an altered red clay, similar in all essential respects to the red clay now forming at the ocean-bottom. There seems thus to be abundant evidence, endorsed by our greatest authorities, that at least some of the Cretaceous deposits were deep-sea, while there is a total absence in them of anything necessarily indicating the proximity of land.* With regard to the Chalk itself, however, the facts are still somewhat contradictory, for it far overlaps the Gault and Grey Chalk in Devonshire, and rests upon greensand; yet although it thins out to the west it remains a perfectly pure rock, without any apparent evidence of the upper part of the formation having gradually shallowed as the sea-bed became upheaved.

The immensity of the gap, seldom adequately realized, between the true Cretaceous and the next overlying beds, implies an interval sufficient to have permitted the grandest changes in the distribution of land and water, and the gulf of the Atlantic, which stretched over the greater part of Europe,

* No American or European so-called Cretaceous land-flora can be proved to be as old as our White Chalk. The few vegetable remains found in marine Cretaceous rocks are not incompatible with the deposits having taken place at a distance from shore.

to become elevated; and, after enormous denudation, to be converted into land.

But even altogether apart from what is to be learned from the Cretaceous rocks, it is not apparent that continents have been uninterruptedly permanent. Australia and Asia, Africa and Madagascar, New Zealand and Australia, Europe and America, are all supposed to have been united at some more or less remote period; and to explain the present distribution of organisms, seas of a thousand fathoms depth are bridged over as often as it happens to be deemed requisite. But it is still questionable whether these former land connexions, which are admitted by Mr. Wallace, will be found sufficient to explain all the past as well as present peculiarities of distribution. For instance, a much more southerly land connexion between England and America seems required to explain the presence of tropical American plants, such as palms, in our Eocene, because their absence in beds of corresponding age in the United States and Greenland implies that they did not pass along the northern route traced out for them. If sea-beds have been elevated to the extent of a thousand fathoms, and if there are forces capable of elevating the highest mountains in the world from below the sea level within a comparatively recent period, why are 'hypothetical continents bridging over the deep oceans' 'so utterly gratuitous and entirely opposed to all the evidences at our command,' as Mr. Wallace wishes us to believe? There appears to be no valid reason why Europe should not have been connected with South America, by the so-called Atlantic ridge, or even Australia with South America by way of Easter, Gambier, and the Fiji Isles; for if these great banks, with islands occasionally rising to the surface, do not mean changes of level in the sea bottom, whether of elevation or depression, what do they mean?

To take other instances, in which Mr. Wallace's explanations do not seem to be the best solution of the facts. Sir Joseph Hooker, in his singularly interesting introductory essay to the New Zealand flora, stated that seventy-seven plants are common to New Zealand, Tasmania, and South America, comparatively few of which are universally distributed species. Further, there are upwards of 100 genera or well-marked groups of plants almost confined to lands of the south temperate zone, effecting 'a botanical relationship or affinity between them all, which every botanist appreciates.' For reasons which appear to be unanswerable, he has rejected the theory that these plants were transported across the seas which now separate these lands, and considers that the plants of the Southern Ocean are 'the remains of a flora that had once spread over a larger and more continuous tract of land than now exists in that ocean,' and that

this land had been broken up by climatic and geological causes. Mr. Wallace supposes an emigration to have taken place from Chili by way of the South Shetland Isles, 500 miles south of Cape Horn, thence by way of an antarctic continent or group of isles, which probably extend around the South Polar area to Victoria Land, again on to the outlying Young Island, across 750 miles of sea to Macquarie Island, and, finally, across another similar distance to the 1000 fathom line, which, he considers, 'probably marks the former southern extension of Tasmania.' This appears a route beset with obstacles both climatal and geographical, and broken up by extents of sea, which Sir Joseph Hooker has expressly stated many of the plants common to these remote lands to be specially unfitted to traverse.* The bed of the ocean is as undulating as the surface of the land; and this is hardly the condition it would have assumed had its state been that of eternal rest. The objection that oceanic islands, with the exception of New Zealand and the Seychelles, hardly ever afford traces of Palæozoic or Secondary formations, and cannot therefore be remains of continents, is far from insuperable. The smaller oceanic islands, to which the statement alone seems to apply, would, if belonging to continental areas, be only the summits of mountains that are either rising or sinking; and as they are mostly of comparatively recent volcanic origin, it is hardly likely that we should meet with Palæozoic or Mesozoic stratified rocks exposed on them. It is even more curious, if they have been uplifted from the great depths which surround them, that no traces of the bottom sediment, which must have been accumulating continuously from the Palæozoic period, should have been brought up with them. Speculation is, however, useless, for the only geological fact regarding them about which we can be certain is that whatever secrets they have to disclose lie buried deeply under volcanic outbursts. It is certainly strange that Mr. Wallace makes no difficulties whatever in admitting changes of level in the sea bottom to the extent of 1000 fathoms, but will not entertain the possibility of any greater upheaval. Yet some oceanic islands must have been upheaved from vastly greater depths, and mountain chains have been raised to three times that extent in comparatively recent times.

It is well known that these forces are unceasingly acting, yet no reason is put forward to show why an elevating force once set in action in the centre of an ocean, should not continue gradually to act until even a continent is formed. In the

* The elevation of from 400 to 1300 feet which Chili and Patagonia have undergone for several hundred miles since the existence of the living species of Mollusca must imply at least correspondingly great subsidence elsewhere.

words of Prof. Huxley, 'Surely there is evidence enough and to spare that the Cretaceous sea, inhabited by various forms, some of whose descendants Sir W. Thomson, as I believe justly, recognizes in the present deep-sea fauna, once extended from Britain over the greater part of central and southern Europe, North Africa and Western Asia to the Himalayas. In what possible sense can the change of level which has made dry land of, and sometimes mountain masses of, nine-tenths of this vast area, be said, to be "in direct relation to the present existing coast-lines." That the abyssal plains were ever all elevated at once is certainly so improbable that it may justly be termed inconceivable; but there is nothing, so far as I am aware, in the biological or geological evidence at present accessible to render untenable the hypothesis that an area of the mid-Atlantic, or of the Pacific sea-bed, as big as Europe, should have been upheaved as high as Mont Blanc, and have subsided again any time since the Palæozoic epoch, if there were any grounds for entertaining it.'*

It is so obvious that the causes which lead to elevation and subsidence must react one upon the other, that I am tempted to speculate upon them and their effects on deep-sea basins. I have long been struck with the almost universal tendency to depression exhibited in areas occupied by deltas and estuaries. The thought has occurred to many, and has perhaps been most clearly expressed by Dr. Charles Ricketts, that this subsidence is produced by the accumulation of sediment.† The cause appears insignificant, yet something must determine the movement of the Earth's crust, and even an accumulation of a few feet of clay over several square miles may create disturbance, and eventually lead to a downward tendency. Supposing a sediment, 50 feet in depth and entirely submerged, to have displaced an equivalent of sea-water, we should have an increased pressure per square yard, taking the mean density of the materials composing a delta at 120 lbs. per cubic foot, of rather more than 25,000 lbs., or about 34,848,000 tons per square mile. As soon as the whole of the sea-water on an area is displaced and movement has set in, every cubic yard of sediment deposited adds a weight of about 3240 lbs.; and when we see that deltas have accumulated to depths of perhaps even beyond 1000 feet, and extend, as in the Mississippi, to 19,450‡ square miles, we can realize how vast a force is present.

* Review of the first volume of the publications of the *Challenger*. *Nature*, vol. xxiii. p. 1.

† *Geol. Mag.* 1872, vol. ix. p. 119.

‡ *Report on Mississippi U. S. War Department*, 1864, p. 434.

Records of borings in deltas are, the Po, 500 feet, Ganges, 481, Mis-

The inference as to the origin of depression, which can be drawn from delta and estuary areas, may equally be applied to coral-reefs and islands, and even to great accumulations of ice, as in Greenland; for in almost all such situations there appears to be a nearly continuous downward tendency. There are even grounds for supposing that the depression generally observable round sea-coasts may be due to a similar cause. The sediments from the wasting of the shore* are known to be thrown down almost wholly upon a belt thirty miles wide. The moving power of waves is not felt to a greater depth than forty feet; and it is therefore difficult to explain, except upon the the theory of subsidence, why in the absence of currents, the sea in proximity to shore should ever be more than forty feet deep. All ancient lands should be surrounded by extensive shoals of uniform depth, for tides appear to have no permanent action in removing sediment, and shore-currents of the requisite power are local. The prevailing action, indeed, on our own coasts appears to be silting, if we may judge from the way wrecks become imbedded; and the evidences of subsidence are innumerable. The records of submerged land vegetation are frequent, and though, on the other hand, there are in many places raised beaches, it should be remembered that while these are always conspicuous, depressed beaches cannot easily attract notice.

If it were once conceded that sedimentation directly caused subsidence, we should discover a reason for the permanence of ocean basins, for deposition must have been unceasing since Palæozoic times, and would to a large extent have filled in the depths of the ocean were this action not compensated by constant and gradual depression, exceeding perhaps the rate of sedimentation. The mean of four experiments made on the *Challenger* expedition, determined the quantity of carbonate of lime in the form of living organisms in the surface waters to be 2·545 grammes, so that if these animals were equally abundant in all depths down to 100 fathoms, it would give 16 tons of carbonate of lime to each square mile of 100 fathoms depth.†

The weight of sediment must exercise enormous pressure, tending to make the *greatest depths* of the sea permanent, and to continually elevate lines of least resistance into ridges or banks, leading where the state of tension is extreme, to

sissippi, 630, in which the lowest beds reached were turf and vegetable matter. The total thickness of many deltas, such as that of the Ganges, may be inferred from the depth of the sea in which they are accumulating.

* The denudation has been estimated to equal nineteen feet in 1000 years.

† In great depths shells are reduced to bicarbonate, and this may imply loss of material. The supply of lime does not seem, however, to be obtained to any great extent from dead organisms, but is probably kept up by rivers.

isolated volcanic outbursts. The lines of absolute least resistance would probably, however, generally coincide with sea-margins, and upon coasts, therefore, while we might find a tendency to local depression, owing to the littoral sedimentation at a few miles from land, there would be inland a far more important and preponderating tendency to elevation.

Thus there would ever be a direct action deepening ocean basins where they are deepest, and raising up the shallower parts to higher levels, thereby slowly lessening the superficial area occupied by seas. On the other hand, the dry land would extend in a corresponding degree, and its surface become more diversified, for new mountain chains would in succeeding ages have a tendency to greater and greater elevation.

I think all we are able to gather from the records of Palæozoic rocks points to a comparative uniformity in the condition of the earth's surface in remote times, there being neither evidence of great depths in the sea, nor of mountainous elevations in the land. These conditions, to judge from palæontological evidence, were increasingly modified during the Secondary period, and on to the present day; so that the theory that increasing weight causes increased depth, derives support from the Geological Record.

PRELIMINARY NOTE ON THE EXISTENCE OF ICE AND OTHER BODIES IN THE SOLID STATE AT TEMPERATURES FAR ABOVE THEIR ORDINARY MELTING POINTS.

By THOMAS CARNELLEY, D.Sc.,
Professor of Chemistry in Firth College, Sheffield.*

IN the present communication I have the honour to lay before the Royal Society a detailed description of experiments, proving that under certain conditions it is possible for ice and other bodies to exist in the solid state at temperatures far above their ordinary melting points. On a future occasion I hope to submit to the Society a full account of the investigation of which these experiments form a part, together with the conclusions to be drawn therefrom. The bodies whose behaviour I propose to discuss at present are ice and mercuric chloride.

Ice.

In the case of ice the great difficulty to be overcome is to maintain the pressure in the containing vessel below 4·6 millims., *i. e.*, the tension of aqueous vapour at the freezing point, for it will be easily understood that if the ice be but slightly heated the quantity of vapour given off would soon be sufficient to raise the pressure above that point. After several fruitless attempts the following plan, involving the principle of the cryophorus, was adopted.

A strong glass bottle, such as is used for freezing water by means of Carré's pump, was fitted with a cork and glass tube C (fig. 1), and the cork well fastened down by copper wire and paraffin wax. A and C were then filled with mercury, and C connected with the end of the tube DE by means of the piece of stout india-rubber pump tubing B, a thermometer having been previously attached by the wire *x* to the lip of the tube

* From the *Proceedings of the Royal Society*, 1881, No. 209.

at B. The connexion at B was made tight by fine copper wire. The tube DE was about one inch in diameter, and about four feet long from the bend to the end E; after connexion with C it was completely filled with mercury, care being taken to expel the air from A, C, and DE as completely as possible; the whole was then inverted over the mercurial trough F, as

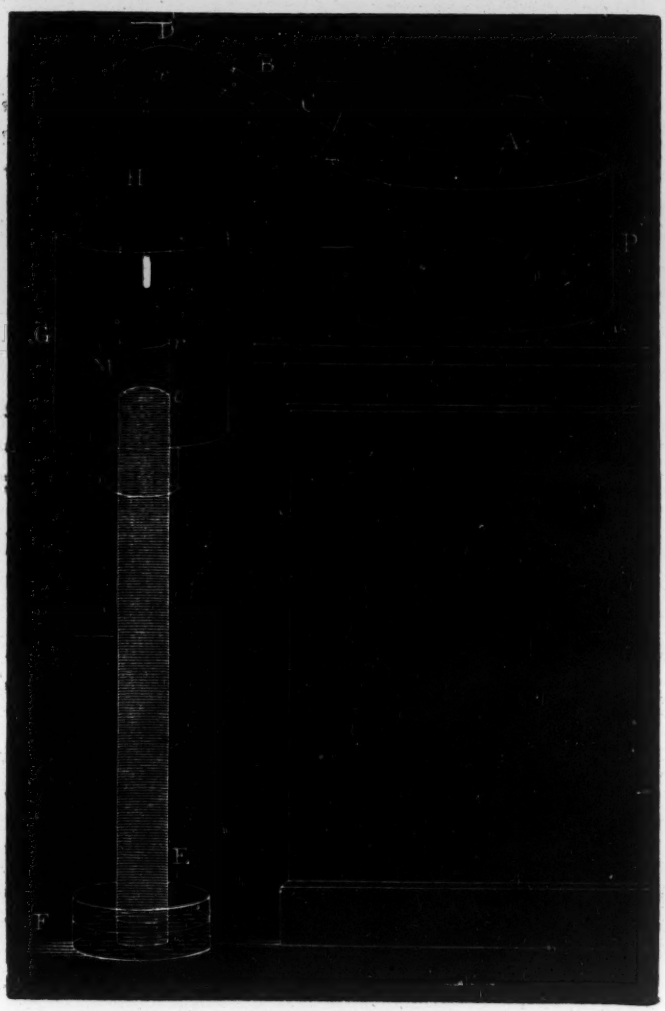


FIG. 1.*

shown in the figure, when the mercury fell to *o*, the ordinary height of the barometer. The mercury was run out of A by tilting up the bottle and inclining the tube DE. By this means a Torricellian vacuum was obtained from A to *o*. DE was next brought to the vertical, and the bottle A placed in the trough P. A tin bottle G without a bottom was fitted with a cork, so that it might slide somewhat stiffly along DE.

* For the use of this and the following figures we are indebted the kindness of the President of the Royal Society.

To begin with, the tin bottle was placed in the position G and filled with a freezing mixture of salt and ice. Some boiled water was then passed up the tube DE, sufficient to form a column at M about two inches deep. The thermometer H had been previously arranged, so that its bulb might be one or two inches above the surface of the water M. The bottle A was next surrounded by a good quantity of a freezing mixture of salt and ice, in order that any vapour given off from the water at M might be condensed in A as fast as it was formed, and thus the internal pressure might never be more than about 1·0 to 1·5 millims. When A had been sufficiently cooled, which required about fifteen minutes, the tin vessel G was slid down the tube DE, and its freezing mixture removed. The water at M had then solidified to a mass of ice, which on heating with the flame of a Bunsen's burner melted either wholly or partially, and the liquid formed began at once to boil. The fusion commenced first at the bottom of the column of ice, whereas the upper part fused only with difficulty, and required rather a strong heat. The fusion in this case was probably due to the steam evolved from the lower portions of the ice column being imprisoned and unable to escape, and hence producing pressure sufficient to cause fusion.

When the greater part of the ice had been melted the tube was tightly clasped by the hand, the heat of which was sufficient to produce a somewhat violent ebullition. The liquid in boiling splashed up the side of the tube and on to the bulb of the thermometer, where it froze into a solid mass, as represented in fig 2. By this means the ice was obtained in moderately thin layers. The tube at the points indicated by the arrows was then strongly heated by the flame of a Bunsen's burner, with the following results :—

The ice attached to the sides of the tube at first slightly fused, because the steam evolved from the surface of the ice next the glass being imprisoned between the latter and the overlying strata of ice, could not escape, and hence produced pressure sufficient to cause fusion, but as soon as a vent-hole had been made fusion ceased, and the whole remained in a solid state, and neither the ice on the sides of the tube nor that on the bulb of the thermometer could be melted, however great the heat applied, the ice merely volatilizing without previous melting. The thermometer rose to temperatures varying between 120° and 180° in different experiments, when the ice had either wholly volatilized or had become detached from the bulb of the thermometer. The ice attached to the latter did not partially fuse at the commencement of the heating, because, the heat reaching the outer surface of the ice first, evaporation could take place from a free surface, and the vapour

not become imprisoned, as was the case with the ice attached to the sides of the tube.

These experiments were repeated many times, and always with the same result, except in one case in which the heat applied had been very strong indeed, and the ice attached to the sides of the tube fused completely. On removing the lamp, however, for a few seconds the water froze again, notwithstanding that the portion of the glass in contact with it was so hot that it could not be touched without burning the hand.

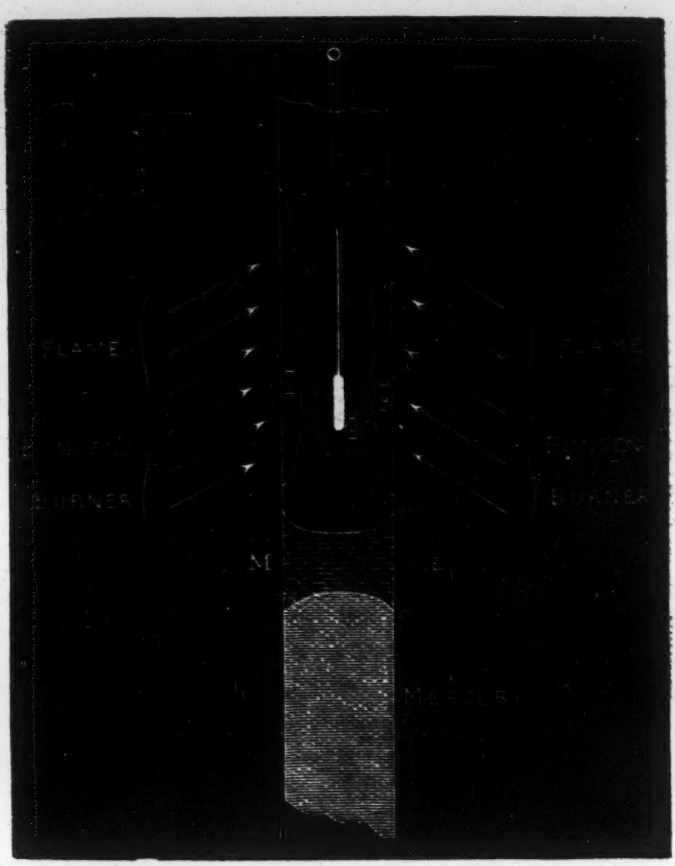


FIG. 2.

The chief conditions necessary for success appear to be—(1) That the condenser (A, fig. 1) is sufficiently large to *maintain* a good vacuum. In the present case the capacity was about three quarters of a litre; (2) That the ice is not in too great mass, but arranged in thin layers. Further, in the case where the heat is applied to the under surface of the layers of ice, the latter must be sufficiently thin to allow of a vent-hole being formed for the escape of the steam coming from below,

otherwise fusion occurs. When the heat is applied to the free surface of the ice, the layers may be much thicker.

Mercuric Chloride,

m. p. = 288° C., re-solidifies at 270–275°, b. p. = 303°.

About 40 grs. of pure mercuric chloride were placed in the tube (A, fig. 3), and a thermometer arranged with its bulb imbedded in the salt. The drawn-out end of the tube was connected by stout india-rubber tubing with one branch of the three-wayed tube B, whilst the other was attached to the manometer C. B was connected with a Sprengel pump, fitted with an arrangement for regulating the pressure.

When the pressure had been reduced by means of the pump to below 420 millims., the mercuric chloride was strongly heated by the flame of a Bunsen's burner, with the following results :—

Not the slightest fusion occurred, but the salt rapidly sublimed into the cooler parts of the tube, whilst the unvolatilized portion of the salt shrank away from the sides of the tube and clung tenaciously in the form of a solid mass to the bulb of the thermometer, which rose considerably above 300° C., the mercury of the thermometer shooting up to the top of the stem. After slight cooling the air was let in, and under the increased pressure thus produced the salt attached to the bulb of the thermometer at once melted and began to boil, cracking the tube at the same time.

The experiment was next varied as follows :—

About the same quantity of chloride was placed in the tube A, fig. 3, as before, and heated by the full flame of a Bunsen's burner. The lamp was applied during the whole of this experiment, and the size of the flame kept constant throughout. The mercuric chloride first liquefied and then boiled at 303° under ordinary pressure, and whilst the salt was still boiling the pressure was gradually reduced to 420 millims., when the boiling point slowly fell to 275°, at which point the mercuric chloride suddenly began to solidify, and at 270° was completely solid, the pressure then being 376 millims. When solidification was complete the pump was stopped working, but the heat still continued to the same extent as before. The salt then rose rapidly to temperatures above that at which a thermometer could be used, but not the least sign of fusion was observed. From the completion of the solidification to the end of the experiment the pressure remained at about 350 millims.

The above experiment, which was repeated three times,

shows, therefore, that when the pressure is gradually reduced from the ordinary pressure of the atmosphere to 420 millims., and the boiling point simultaneously from 303° to 275°, the salt solidifies while it is still boiling and in contact with its own hot liquid, notwithstanding that it is being strongly heated at the same time; and that, after solidification is complete at 270°, the temperature then rises far above the ordinary boiling point (303°) of the substance without producing any signs of fusion.

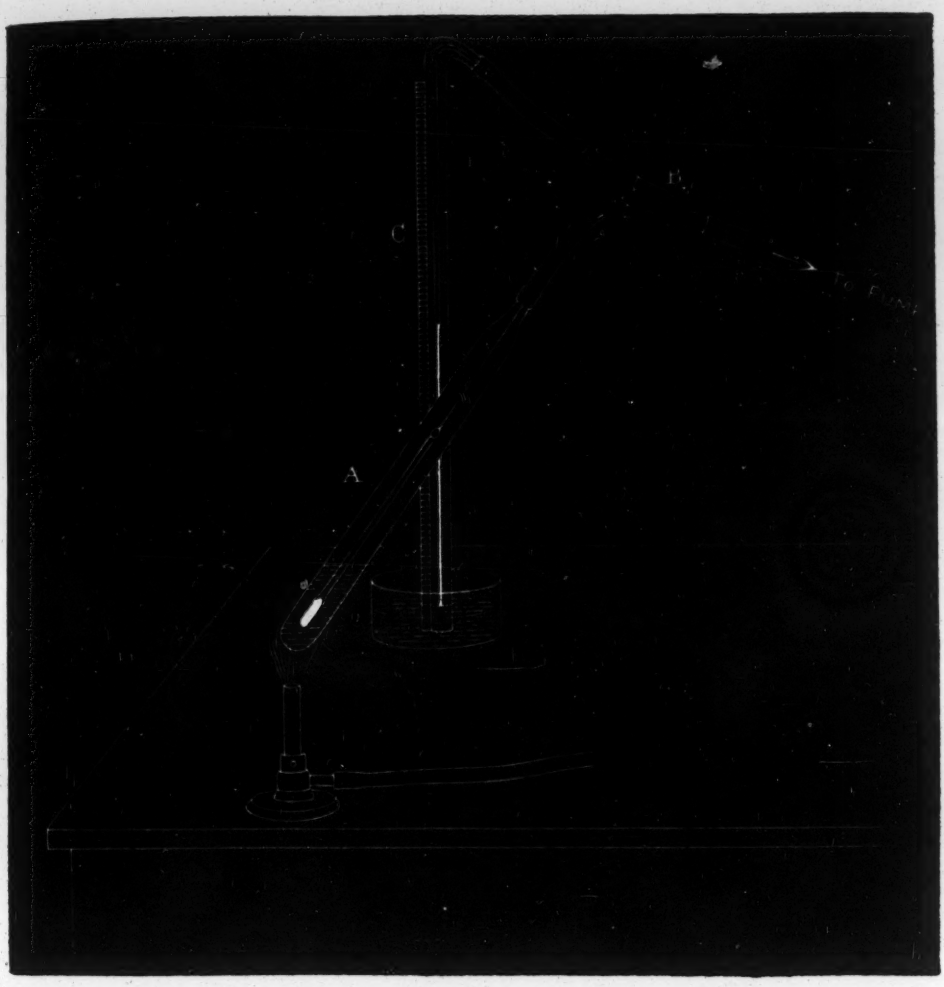


FIG. 3.

Under ordinary circumstances, mercuric chloride melts at 288° and re-solidifies at 270—275, *i. e.*, at a temperature identical with that at which it solidifies under diminished pressure, as above described.

The solid mercuric chloride obtained on solidification under the combined influence of diminished pressure, and the application of a strong heat had a peculiar appearance, quite different

from that produced when the substance is allowed to solidify in the ordinary way. It appeared to consist of a mass of pearly leaflets closely packed together round the bulb of the thermometer.

Any final explanation of these phenomena is reserved until further experiments have been made.

Since writing the foregoing, it has been said in explanation of the phenomena therein described, that the thermometer, though imbedded in the mass of the ice, did not really indicate the true temperature of the latter. With the object, therefore, of proving whether the ice is hot or not, I have, at the suggestion of Professor Roscoe, made the following calorimetrical determination:—

The arrangement of the apparatus was so modified, that the ice, after being strongly heated, could be suddenly dropped into a calorimeter containing a known quantity of water of known temperature. The resulting temperature, after the ice had been dropped in, was read off by a thermometer graduated so as to indicate a difference of 0°·05 C. The weight of the ice was found by re-weighing the calorimeter.

So far, I have only had the opportunity of completing the two following determinations, and in the second of these the weight of the ice could not be found, as a small quantity of water was lost out of the calorimeter, owing to a sudden jerk at the moment the ice entered it:—

(1.) Weight of water in calorimeter, including the value of the latter = 185 grms.

Weight of ice dropped in = 1·3 grms.

Temperature of calorimeter before . .	=	13°·4
„ „ after . .	=	13·6
Rise in temperature	=	0·2

$$M(\theta - t) + 80\,W = W(T - \theta)$$
$$(185 \times 0{\cdot}2) + (80 \times 1{\cdot}3) = 1{\cdot}3(T - 13{\cdot}6)$$

$\therefore T = 122°$ C. Where T = temperature of ice.

(2.) Weight of water in calorimeter, &c. = 185 grms.

Temperature of calorimeter before . .	=	12°·7
„ „ after . .	=	12·8
Rise in temperature	=	0·1

On weighing the calorimeter after the experiment, the increase in weight was only 0·15 grms., but as a portion of the

water had been jerked out during the operation, the true weight of the ice, and therefore its temperature, could not be found. But since the calorimeter had slightly risen in temperature, the ice must have been above 80° C.

From the nature of the experiment, as carried out on the present scale, the weight of the ice which can be dropped into the calorimeter is only small, and therefore the rise in temperature is but slight. But since a fall in temperature of a much larger amount ought to have been obtained had the ice been at 0°, it is considered that the above experiments are conclusive. Great care was taken, in order to obtain correct temperatures in the calorimeter. The latter was enclosed in several casings, and the water was allowed to stand in it for several hours before the experiment, so that it might first attain the temperature of the room, whilst the time which elapsed between the readings of the thermometer before and after the ice was dropped in would not be more than from 10 to 15 seconds.

In the course of the next few weeks I intend to make one or two more determinations, and, if possible, on a larger scale.

ON THE FORMER EXISTENCE OF THE ROE-DEER IN ENGLAND.

By J. E. HARTING, F.L.S., F.Z.S.

IT is always a pleasing exercise of the understanding to investigate the causes which produce important changes in animated nature; and this is especially the case when those changes have relation to our own country, and to animals which, once common here, have from one cause or another become extinct.

Our old English foresters were wont to distinguish three classes of game, namely, Beasts of Venery (or of the forest), as the Hart and Hind, Boar and Wolf; Beasts of Chase, as the Buck and Doe, Fox, Marten, and Roe; and Beasts and Fowls of Warren, namely, the Hare, Coney, Pheasant, and Partridge.

When Turbervile, three centuries ago, wrote his *Book of Hunting*, and woodcraft in all its branches was accounted an essential part of a gentleman's education, the Roe-deer held an important place amongst the 'beasts of chase.' During its first year it was termed a *kid*, the second year a *gyrle*, the third year a *hemule*, the fourth year *a Roebuck of the first head*, and the fifth year *a fair Roebuck*. When several were seen together they were spoken of as a *bevy* of Roes; and the season for hunting them was between Easter and Michaelmas for bucks, and between Michaelmas and Candlemas for does. While a hart was 'harboured' and a buck 'lodged' in the fern or underwood, a roe was said to be 'bedded.' The voices of all three were distinguished, and it was said the Red-deer 'belleth,' the Fallow-buck 'groaneth,' and the Roe-deer 'belloweth.' The first named was tracked by his 'slot,' the second by his 'view,' the last by his 'foil;' and, in the ancient jargon of the chase, various were the terms applied to each when hunted.

It is not a little curious that of the three species of deer

which were once plentiful in England, the smallest should be the first to become extinct.

One would have supposed that its diminutive size, its timid disposition, and retiring habits, combined with fewer requirements as regards food, would have enabled it to linger on and hold its own in the remnants of our ancient forests, and even in smaller coverts where its allies, the Red-deer and the Fallow-deer, from their conspicuously larger size could not hope to escape detection. This might have been so had it not been for the important circumstance that both the Red-deer and Fallow-deer were at an early period taken directly under man's protection by being enclosed in parks on the first distribution of forest lands.

The Roe-deer not only disdained such protection, no ordinary park-paling being high enough to keep it within bounds, but its wandering disposition necessitating a great tract of country to roam over, rendered it unable to brook the confinement to which the larger animals soon became accustomed. Under these circumstances other causes soon supervened to bring about its extinction. Deprived of the protection afforded to other deer, the destruction of its native woods and the gradual cultivation of moors and waste lands placed it more than ever at the mercy of its enemies. It would be easily approached and killed, its size rendering it a good mark; and on the other hand its slow rate of increase (bringing forth but once a-year, and having usually but two fawns at a birth), would be insufficient to counteract the destruction to which it became continually exposed.

That the Roe-deer must at one time have been plentiful in England, and very generally dispersed throughout the country, is made apparent in a variety of ways.

To turn, first, to the geological evidence. Its remains have been discovered in such widely distant and dissimilar situations as in the barrows and bone-caves of Derbyshire,* in the peat of Berkshire and Hants,† in the deposits of the Thames Valley,‡ in the lower marl of the Vale of Kennet,§ and in the caverns of Devonshire.‖ That it was at one time a native of the eastern counties of England may be inferred from the discovery of its horns and bones mingled with those of the Red-deer and other animals, now extinct, in the soil of an ancient submerged forest

* Pennington, *Notes on the Burrows and Bone-caves of Derbyshire*, 1877.

† Collet, *Phil. Trans.* 1757, p. 109; Pennant, *Brit. Zool.* vol. i. p. 60.

‡ Boyd Dawkins, *Pop. Sci. Rev.* Jan. 1868; Woodward, *Geol. Mag.* Sept. 1869, and Walker, *Trans. Essex Nat. Field Club*, p. 38.

§ *Sussex Archæol. Coll.* xxiv. p. 160.

‖ Bellamy, *Nat. Hist. South Devon*, p. 440; *Brit. Assoc. Report*, 1869, p. 208.

which has been found to extend for more than forty miles along the coasts of Norfolk, and which during the prevalence of very low tides is traceable here and there by the numerous stumps of trees which may be seen still standing erect with their roots attached to them, and penetrating in all directions into the loam or ancient vegetable soil on which they grew.*

'The horns of the Roebuck,' says the Rev. Richard Lubbock,† 'are much less frequent in occurrence here than those of the Stag; but a good pair, with part of the skull annexed, were dug up by the turf-cutters on Buckenham Fen, near Attleburgh, and they have occasionally occurred in other situations.'

If we dip into the records of bygone days we shall find that the Roebuck is very anciently mentioned as a beast of chase. The British name for it was *Iwrch.* In the *Colloquy of Alfric* it is included amongst the different kinds of game which the Saxon hunter usually pursued. 'I take harts, boars, and deer,' he says, 'and roes, and sometimes hares.' When asked how he practises his craft he replies, 'I braid nets and set them in a convenient place, and set on my hounds that they may pursue the beasts of chase, until they come unexpectedly to the nets, and so become entangled in them, and I slay them in the nets.'

The practice of taking Roe-deer in nets is referred to in Domesday as being in vogue in Lancashire at the date of the Conquest. Thus, '*Rogerius de Laci teñ Cortune. Ibi est haia capreolis capieñd.*'

The haia, haye, or haie, as it is variously spelled, properly signified the hedge or fence enclosing a forest or park, but by an easy metonymy the word was transferred from the enclosing fence to the area enclosed by it.‡ In the case of the Roe-deer it doubtless implied an enclosed area into which the animals were driven, and having outlets here and there across which nets were hung for their entanglement and capture. The existence of such 'haies' may be found noticed in ancient grants of land during many subsequent centuries.§

Under the Welsh laws of Howel Dha, A.D. 940 (cap. xix.), the skin of a Roebuck was worth a penny, of a Hart eightpence, of a Hind sevenpence.‖ The Welsh name for the Roe was *Iyrchod.*

At the time of the Conquest, Roe-deer were to be found

* Lyell, *Antiquity of Man.*

† Lubbock, *Fauna of Norfolk.*

‡ For a full and interesting explanation of this word see Whitaker, *History of Whalley,* vol. i. p. 283.

§ See Blount's *Ancient Tenures.*

‖ An English translation of these laws will be found appended to *The Myvyrian Archæology of Wales, collected out of Ancient Manuscripts,* ed. Owen Jones and others. (Denbigh, 1870.) *Vide* p. 1056.

in the isle of Ely. From an account of the natural productions of this island, drawn up for the information of the Conqueror, and embodied in what is now known as the '*Liber Eliensis*,' it appears that Ely at that date was remarkably fertile in its resources, not only affording pasturage to numberless flocks and herds, but yielding plenty of fish and wild fowl, as well as harts and hinds, roes and hares, which abounded in its woods.* William the Conqueror punished with the loss of eyes any who were convicted of killing a wild boar, stag, or roebuck.

In the year 1183, Bishop Pudsey caused a survey to be made of the various estates of his see in the county of Durham, with a specification of their respective tenures, rents, and services. This survey is generally called the 'Boldon Book,' Boldon being the first place mentioned in it. From entries in this book, it appears that the early Bishops of Durham were mighty hunters, and their tenants often held lands by the service of protecting the deer, and furnishing horses, greyhounds, and other dogs for the chase. It appears, moreover, that the *villani* and farmers were wont to assemble from time to time at the summons of the Bishop, for the purpose of constructing 'haies,' and assisting at a roe-hunt:—

'*Omnes villani de Aukelandschire scilicet de North Aukeland et West Aukeland et Escumba et Newtona . . . faciunt partem suam de haia circa logias. . . . Præterea omnes villani et firmarii eunt in "rahunt" ad summonitionem Episcopi.*' †

In this same county is a place called Reshope, otherwise Reshoppe and Rosheppe,‡ *i. e.* Roe's hop, or jump, in all probability indicating some famous 'deer-pass' in the days when these animals were common in Durham. So also in Lancashire, its former occurrence in Bowland, says Whitaker, is pretty plainly indicated in the perambulation by the word 'roe-cross.'

In ancient charters conveying the royal license to enclose certain forest-lands, or to hunt in particular counties or districts, the Roebuck is sometimes mentioned amongst other animals which might be enclosed or hunted. Thus from a charter of liberties granted by King John, when Earl of Morton, to the inhabitants of Devonshire, it appears that Roe-deer at that date were included amongst the beasts of chase in that county. This deed, the original of which is still preserved in the custody of the Dean and Chapter of Exeter, is under seal, and provides, *inter alia*, as follows:—

'*Quod habeant canes suos et alias libertates, sicut melius et*

* See *Fenland Past and Present*, p. 356.

† *The Boldon Book*, p. 26 (Surtees Society), and Raine, *Hist. Acct. of the Episcopal Palace of Auckland*, p. 5.

‡ *The Boldon Book*, p. 6.

liberius illas haberunt tempore ejusd. Henrici regis et reisellos suos, et quod capiant capreolum, vulpem, leporem, etc., ubicumque illa invenirent extra regardum forestæ meæ.'

It will be observed that the word here employed is *capreolus;* in many old grants, however, the term used to designate the Roebuck is *caprea,* which, from its similarity to *capra,* has led some translators to suppose that the goat was intended. But, in the first place, the context usually shows that the animals included in a licence to hunt, or to enclose, are beasts of the forest or of chase, while the goat does not fall within either category, being rather an animal of the hillsides and mountains; and, in the next place, contemporary translations of such passages go to prove that, even in cases where the term employed is *capra,* or *caper* (perhaps so written in error by the transcriber), the animal so designated is evidently the Roebuck.*

In the time of Edward III., there were plenty of Roe-deer in the ancient forest of Pickering, in the North Riding of York; and in 1340 a prosecution by the Crown was instituted against Henry de Percy, lord of the adjacent Manor of Semere, for allowing his woodward to carry a bow and arrows, and chase and take Roe-deer within the limits of this forest. It appears, however, that the defendant established a right of free-warren, and pleaded that the Roe was a beast of warren and not of the forest.† Perhaps it was on this case that Lord Coke relied, in holding the Roe to be a beast of warren, a decision opposed to the opinion of many old English writers on venery, who included this animal amongst the beasts of chase.

We learn from Holinshed, that in Henry the Fifth's time (1413–22), deer were so numerous in England as to be very destructive. 'Although,' he observes, 'of themselves they are not offensive at all, yet their great numbers are thought to be very prejudiciall, and therefore justly reproved of many. Of these also the stag is accounted for the most noble game; the fallow deere is the next, then the roe, of which we have indifferent store.'

The author of the ballad of 'The Battle of Otterbourne' was guilty of no anachronism, when in the following lines he introduced the Roe as one of the characteristic animals of Northumberland in 1388.

* A case in point is furnished by John of Trevisa's translation of the *Polychronicon* of Ranulphus Higden, to which we shall presently have occasion to refer.

† *Placita coram Rege apud Westm. Term Hil.* 13 Ed. III. *Rot.* 106, *Ebor.*

'The roo full rekeles ther sche rinnes
To make the game and glee,
The fawkon and the fesaunt both
Amonge the holtes on hee.'

For, a hundred and fifty years later, Leland was able to testify that this animal was then still common in the north of England. He remarks in his *Itinerary*, 'In Northumberland, as I heare say, be no forests except Chivet Hills,* and there is great plenty of redde deare and row-bukkes.' According to a Report of Royal Commissioners furnished to Henry VIII. in 1512, there were nearly 6000 head of deer, Red, Roe, and Fallow, in the forests and parks of the Earl of Northumberland in the northern counties, at which date there were Red-deer in the forest of Rothbury.†

About 1530–34, as we learn from the *Durham Household Book*, Roe-deer were to be found in the adjoining county. Thus at p. 142 we find the entry:—

'*Et Eduardo Denynge et Johanni Greynsweyrde, per* 4 *dies apud Mugleswyk* [Muggleswick] *deferentibus* 4 *roys in regardis* . . . . . 12*d.*'

Here it is evident from the context that Roe-deer are intended, for the entries which precede and follow this all relate to venison brought in. At times the Latin name is bestowed, but generally the English; thus we find:—

'*Et famulo Abbatis de Fountanc' deferenti* 1 *buk bursario.* 3*s.* 4*d.*'

'*Et Thomæ Harper deferenti damam domino Priori, Dominica prima Adventus à Roberto Crosby* . . . 20*d.*'

'*Et Lionello Smyth et Eduardo Denynge deferentibus* 1 *stage à Mugleswyk* . . . . . 20*s.*'

The existence of Roe-deer in Wales was noted by Leland in Henry VIII.'s time; and Camden has noticed several Welsh localities which from their name seem to indicate former haunts of this animal, as Bryn-yr-Iwrch, Phynon-yr-Iwrch, Lhwyn-Iwrch, &c. Pennant informs us that, according to Dr. Muffett, they were still to be found there in the reign of Elizabeth.‡ On turning to Dr. Muffett's work,§ we find the bare statement (p. 75) that 'the Alps are full of them in high

* It is curious that Leland should have made this statement, for beside Cheviot, there were in Northumberland the forests of Rothbury, Redesdale, Eresdon, Lowes (anciently Loughs, from the number of lakes in it), Allendale, and Knaresdale.

† Wallis, *Nat. Hist. and Antiq. of Northumberland* (1769), vol. i. p. 410.

‡ *British Zoology*, vol. i. p. 59.

§ *Health's Improvement*, by Dr. Thomas Muffett, corrected and enlarged by Christopher Bennett, 1655. The author died in 1590, but it does not appear that there was any earlier edition of his work than that of Bennett, who probably revised the original MS. See Wood's *Athenæ* (ed. Bliss), vol. i. p. 575.

Germany, and *some of our mountains of Wales are not without them.*' It is to be regretted that Dr. Muffett did not particularize the localities in Wales where he supposed the Roe-deer to exist, for a contemporary of his expresses a very different opinion. George Owen, of Henllys, writing of the wild animals of Pembrokeshire in his time (1595), informs us that 'for Roes, the countrey yeeldeth not any, neither did I ever heare of any by reporte of the auncient men, to have been usual in this countrey.'*

One of the most interesting records which we have met with in the course of our researches on this subject, is that which relates to the transport of some Roe-deer from Cumberland to Surrey in the reign of Charles I. The king had expressed a wish to have some turned out at Wimbledon in one of the royal parks, and application was made to Lord William Howard of Naworth Castle, Cumberland (where we may presume Roe-deer were then common), to have some caught and sent up. Directions for this purpose were accordingly given, and what followed may be gathered from the following entries in the *Household Book* of the owner of Naworth:—

'1633, June 29.—To severall persons for takeinge 31 Roe-kidds, as appeareth by bill . . vijli xijs vjd.'

They were, no doubt, taken in a 'haie' with nets, according to the ancient practice; and after being kept in an enclosure for a fortnight until they had got more tame and accustomed to confinement, they were ready to be moved to London. This was accomplished by means of three carts, as we learn from the next entry:—

'1633, July 16.—To Wm. Lancaster the Smith, for binding 3 payre of wheeles with iron which carried Roes to London . . . . . vli xvjd.'

And subsequently on the return of these carts:—

'For repairinge 3 cartes sent with Roes to London to Kinge Charles thether and home again . . xvs. xd.'

How these animals fared in their new home in Surrey we are not accurately informed; but it may be surmised that they throve and did well, for a few years later, viz., on January 17, 1639, a warrant was issued to Sir Henry Hungate for 'the preservation of His Majesty's game of Roe-deer broken out of Half-Moon Park, Wimbledon, and now lying in the woods adjoining thereto, and to take care that no person hunt, course, or use any net or gun, within four miles of the said park.'†

When the Roe-deer became extinct in England is not quite

* For some notice of this writer and his MSS., see Fenton's *Historical Tour through Pembrokeshire*, 4to, 1811, pp. 524, 562, 563 note, and Appendix, p. 54.

† S. P. Dom. Charles I. ccccix. 105, Docquet.

certain. In Percy's *Reliques of Ancient English Poetry*, in a footnote to the passage in the 'Battle of Otterbourne' above quoted, it is stated that Roebucks were to be found upon the wastes not far from Hexham in the reign of George I., and that Mr. Whitfield of Whitfield is said to have destroyed the last of them. This is probably the instance referred to by Scott in his *British Field Sports*, who states (p. 381) 'that the last of its race in England was, it seems, killed in Northumberland about seventy years ago;' but, if so, his book having been published in 1818, he would have been nearer the mark had he said 'ninety' or even 'a hundred years ago.'

An exceptional instance, however, of the capture of a wild Roe in Northumberland, occurred early in the present century, and is thus recorded by Bewick in his *History of Quadrupeds* (ed. 1807, p. 148):—'Some years ago one of these animals, after being hunted out of Scotland, through Cumberland, and various parts of the North of England, took refuge in the woody recesses bordering upon the banks of the Tyne between Prudhoe Castle and Wylam. It was repeatedly seen and hunted, but no dogs were equal to its speed; it frequently crossed the river, and either by swiftness or artifice eluded all its pursuers. It happened during the rigour of a severe winter, that being pursued, it crossed the river upon the ice with some difficulty, and being much strained was taken alive. It was kept for some weeks in the house, and was then again turned out, but all its cunning and activity were gone; it seemed to have forgotten the places of its former retreat, and after running some time, it laid down in the midst of a brook, where it was killed by the dogs.'

The late Prof. Garrod, in his recently published account of the *Ruminantia* in Cassell's *Natural History*, vol. iii. p. 63, states that the Roebuck 'still survives in the woods of Westmoreland and Cumberland,' but gives no authority for this statement, nor any further particulars.

The species had probably been extinct in England for some years, when Lord Dorchester, in 1800, turned some out in the woods at Milton Abbey, Dorsetshire, from whence their descendants dispersed in a very short space of time, especially in a south-westerly direction. They were frequently hunted, and afforded excellent sport. About 1829, when the Master of the Hounds, Mr. Pleydell, gave up his pack, after hunting Roe-deer exclusively for sixteen years, he permitted Mr. Drax, of Charboro Park, to capture several of these deer and turn them out in the Charboro Woods. From this second centre they increased in numbers, and wandered far and wide,—from Moreton to Warmwell in the valley of the Frome, and from Hyde to Houghton in that of the Puddle. Their extreme

eastern extension at present is Lychett, and they have been met with as far west as Hook Park. Mr. J. C. Mansell Pleydell informed the writer, that in 1879 he estimated there were no less than 120 head in the Milton, Whatcombe, and Houghton Woods, which fringe the southern side of the Vale of Blackmore, from Stoke Wake to Melcombe Park and the Grange Wood westward, the number being merely a question of preservation or non-preservation.*

Chafin, in his *Anecdotes of Cranbourn Chase,* mentions the Roe-deer as an animal indigenous to that part of the country; but as his book was not published until 1816, it seems possible that the presence of the Roes in Cranbourn Chase (where a few are still to be found) may have been due to Lord Dorchester's experiment commenced six years previously. At all events, Chafin says nothing of the existence of the Roe-deer in the Chase prior to 1800.

Dorsetshire is now the only county in England, it is believed, where Roe-deer still exist in a wild state; not because the ancient race have survived there till now, but because, as we have seen, it was reintroduced at the commencement of the present century, by turning out a few brace procured from Scotland.†

In 1810 there were a good many Roe-deer in the woods belonging to the Earl of Egremont at Petworth, Sussex. A skull of one of them (a female, with rudimentary horns) was presented in that year by Lord Egremont to the Museum of the Royal College of Surgeons, where it is still preserved (No. 3598 D),‡ and the abundance of Roes in the Petworth woods at that date, is proved by his lordship's letter which accompanied the specimen referred to, and which is printed in the *Museum Catalogue of Monstrosities,* part v. p. 17.

The writer has been recently informed by Lord Leconfield, the present owner of Petworth House, that there is a tradition to the effect that the Roe-deer were introduced there, and were not the descendants of an ancient stock. About thirty years ago, some were sent as a present to Prince Albert, and were turned out at Windsor, where a few are still preserved in the neighbourhood of Virginia Water. Those which still survive at Petworth are kept in the park, which being surrounded by a

* See *The Zoologist,* 1879, pp. 120, 170, 209, 262, 301.

† In addition to the information given on this point in *The Zoologist* for 1879, above quoted, the reader will find further details in *The Sporting Magazine* for 1817, in Scott's *British Field Sports,* p. 381, and in Gilpin's *Forest Scenery* (ed. Lauder), vol. ii. p. 301.

‡ This skull is figured in the *Proceedings of the Zoological Society,* 1879, p. 297, in illustration of some remarks on female deer with antlers, by the late E. R. Alston.

wall fourteen miles in length, affords them unusual security and yet abundant liberty.

In Scotland, the Roe-deer was once much more common than it is at present, although it is still plentiful in some parts of the country, and has even increased of late years.

It is believed that the increase of plantations in the south of Scotland has been the means of spreading it much further in that direction than it used formerly to be found.

In Ireland the Roe-deer is unknown, and since no remains of it have been discovered, it seems probable that it was never indigenous to that country, although some have asserted otherwise, on the authority of Bede. John of Trevisa, however, in his translation of Higden's *Polychronicon*, observes: 'Beda seith that there is grete huntynge of Roobukkes (*caprorum* is the word used by Higden), and it is i-knowe that Roobukkes beeth noon there. It is no wonder of Beda, for Beda knew nevere that ilond with his eyes; bot som tale tellere told hym suche tales.'* On the other hand, if the testimony of Ossian be admitted, it would seem that the Roe was not uncommon formerly in Ireland. There are many very striking passages in which that poet adverts to the hunting the Roe-deer there. He thus pictures the animal's haunts:—'Lumon of foaming streams . . . . the dun Roe is seen from thy furze; the deer lifts his branchy head, for he sees at times the hound on the half-covered heath.' *Temora*, book vii. Again:—'The king rejoiced as a hunter in his own green vale, when after the storm is rolled away, he sees the gleaming sides of the rocks. The green thorn shakes its head in their face; from their top look forward the Roes.' *Temora*, book viii.

Strange to say, also, the Roebuck is mentioned as a native of Kerry in an Irish MS. poem of the ninth century, which is thus referred to by the late Sir W. Wilde: †

'In the collection of Irish MSS. preserved in the Library of the University of Dublin, is a very curious zoological and topographical poem, the original of which is believed to be as old as the ninth century; it is certainly one of the most remarkable productions of its kind known in any language in Europe of the same date. The history of this poem is as follows:—Finn Mac Cumhaill was made prisoner by Cormac Mac Art, monarch of Erin, who, however, consented to liberate him when a ransom of two of every wild animal in Ireland—a male and female—were brought before him on the green of Tara. Cailte Mac Ronain, the foster-brother and favourite of the

* See also *The Book of Howth*, Brewer and Bullen, Calendar Carew MSS. p. 32.

† *Proc. Roy. Irish Acad.* vol. vii. p. 182.

celebrated Irish general,* having first performed many remarkable feats at Tara in the king's palace, undertook and succeeded in accomplishing this apparently hopeless task within a twelvemonth; and in this poem is said to have related to St. Patrick the result of his mission. There is, perhaps, no other example in the Irish language of the same extent containing so many words—names of animals—of which the meaning is not known; and there are but few poems of so many lines requiring the same amount of topographical annotation. The names of several animals are, as stated, untranslatable; either the animals themselves have become extinct in Ireland, or they are now known by other names than those preserved in the MS.' As a specimen we quote the following lines:—†

'I then went forth to search the lands,
To see if I could redeem my chief,
And soon returned to noble Tara
With the ransom that Cormac required.

'Two foxes from Slibh Cuilinn [co. Armagh],
Two wild oxen from Burren [co. Clare],
Two swans from the dark wood of Gabhran,‡
And two cuckoos from the wood of Fordrum.'

The most remarkable line, however, so far as concerns our present inquiry, is that which relates to the bringing of two Roebucks (*Earbóg*) from Luachair Deaghaidh, *i. e.*, Slieve Lougher, Co. Kerry.

We are not informed upon what authority the word *Earbóg* is rendered 'Roebuck.' It seems not a little curious that the Irish in the ninth century should have had a name for an animal which, it is supposed, was never indigenous to Ireland; at the same time, it should be observed that the Irish name, *Earbog*, closely resembles the Gaelic names for this animal (Earb, Earba, Earb-boc) in use at the present day.

It is worthy of remark, too, that in the Museum of the Royal Irish Academy, amongst the collection of Irish Red-deer horns, is a small specimen catalogued as 'No. 45, a small shed horn, *apparently of the Roebuck*, presented by Joshua Ferguson, Esq.' Not having seen this specimen, we can express no opinion upon it; but if it be really the horn of a Roebuck found in Ireland, its history would be worth tracing.

* See *Annals of the Four Masters*, under A.D. 286.

† A translation of this poem appeared in the *Dublin University Magazine*, March 1854, and the Irish version, with the translation opposite, is given in the seventh volume of the *Proceedings of the Royal Irish Academy*, 1859, pp. 184–191.

‡ Now Gowran, co. Kilkenny.

CONTRIBUTIONS TO THE KNOWLEDGE OF THE HOTTENTOT RACE.

By M. J. A. ROORDA SMIT.*

DIFFERENT travellers who have had the opportunity of comparing the Hottentots and the Chinese, have found a great analogy between the two races. The first who remarked it were the old colonists of the Cape, who even gave to some tribes the name of 'Chinese Hottentots.' In England, also, John Barrow drew attention to this singular fact.†

When, at a later period, Chinese coolies arrived at the Cape, their resemblance to the Hottentots was found to be striking, and led to frequent errors. Wood speaks of a traveller who believed that he had a Hottentot servant, and who discovered, only after some time, that the man was a Chinese.‡

During my stay in South Africa, I have been more than once witness of similar facts. At the Cape, for instance, I have seen a Chinese and a Hottentot both serving in the same hotel; as they were dressed almost in the same style, we were constantly confounding them, taking the Asiatic for the African, and *vice versa*. At the Diamond fields I met with a case of the same kind.

In order to give a general character of the Hottentots, I cannot do better than quote the following passage from Von Siebold: 'The breadth and coarseness of the face, the prominence of the cheekbones, the development of the jaws, the flattened form of the bridge of the nose, and the enlarged nostrils, the size of the mouth, the thickness of the lips, the apparent obliquity of the eyes, the stiff, abundant hair of a brownish-black colour, or inclining towards red, the heaviness of the eyebrows, the scarcity of the beard; and lastly, a wheat-coloured, yellowish-red complexion distinguish them,' &c.§

* From the *Archives Néerlandaises des Sciences exactes et naturelles*, tome xv. livr. 5.

† Barrow, *Voyage to Cochin China*.

‡ *Natural History of Man*, p. 241.

§ Prichard, *Nat. Hist. of Man*, vol. i. p. 232; *Catalogue du Musée Vrolik*, par Dusseau, p. 32.

I need only remark, concerning the hair, that among the Hottentots it is curly and does not cover the head uniformly; it forms patches separated by bare spaces. Moreover, as regards the complexion, the expression, 'yellowish-brown,' would be more suitable, at least in certain cases, than 'yellowish-red.'

Now, in giving this description, Von Siebold did not refer to the Hottentots, but to the Mongols who inhabit the Corea, a country tributary to China.

Dr. Carpenter describes the Hottentots in the following terms: 'Thus the face presents the very wide and high cheek-bones, with the oblique eyes and flat nose of the northern Asiatics; at the same time that, in the somewhat prominent muzzle and thick lips, it resembles the countenance of the Negro. The hair is woolly, like that of the Negroes, but it grows in small tufts scattered over the surface of the scalp (like a scrubbing-brush) instead of covering it uniformly; thus resembling in its comparative scantiness that of the northern Asiatics.' *

A long time before the Dutch East India Company had taken possession of the Cape, vessels of other nations had already dropped anchor in Table Bay and made the acquaintance of the inhabitants of the country (1497–1652). But the accounts of these voyages, of which the sole aim was commerce, give us little information about the inhabitants.

The Portuguese, who changed the original name 'Quai-qua, Khoi-khoiu, Kanimou-qua?' into that of 'Saldanhas,' learned more than once, to their cost, that the population, though weak and not numerous, could defend itself and was vindictive. (1497, Vasco de Gama; 1510, Francisco d'Almeida; 1516 (?), Emmanuel de Souza.)

The Dutch and English had rather less to complain of. (1598, John Davis; 1601, English East India Company and Paul de Corniden; 1608, Maaklof; 1648, Leendert, Jansz. and Nic. Proot, Van Riebeek.)

The natives of the Cape received from the Dutch the name of 'Ottentos,' which has since become 'Hottentots.' At the time when the Europeans became acquainted with them, they were nomads, who changed their abode continually and lived in 'kraals,' the huts of which were easy to take down and put up elsewhere. They were acquainted with metals—at all events with iron—which they knew how to work. Their acquaintance with this metal, however, does not seem to have been very general, as it was considered a precious article, although iron ores are not rare at the Cape, particularly in Namaqua-land.

* Carpenter, *Physiology*, fifth ed. p. 897.

In 1601, the ships of the English East India Company obtained sheep and cattle in exchange for pieces of old iron.

Their weapons were the bow and arrow. When, later on, they came in contact with the Caffres, they adopted from them the 'zagaie.' At the time of the voyage of Le Vaillant (1781), the use of this weapon had spread very little among them, and the Hottentots, who already possessed 'zagaies' had not yet learned to make use of them very cleverly. Their clothing consisted of dressed skins, more or less ornamented. They knew very well how to remove the hair from skins.

A peculiarity which is also found among the Caffres, is the circular form of their huts and of their camps. It seems that no South-African race can easily draw a straight line.

The geographical distribution of the Hottentots is often described incorrectly. To judge of it from my own researches, they must have originally inhabited the south-west side of the Cape, *that is to say, only the coast region!*

While the Hottentots were in possession of the western part of the Cape, the Caffres occupied the eastern part (1500, Cabral). The shipwrecked sailors of Souza's ship reached on the east (eastern coast) an *Ethiopian* village where they embarked. We cannot here imagine any confusion with the Hottentots, seeing that the sailors in question knew the latter perfectly, having seen them before. In 1684 an expedition of thirty-nine Boers found, in the eastern part of the Cape, some Caffres who had never yet seen a white man. It seems that the Hottentots at that time had no knowledge of the neighbourhood of the Caffres. It was probably about 1700 that they came in contact with them. From these connexions have resulted the mixed races of the 'Gonaqua' and the 'Gonaquebi.' When Le Vaillant travelled amongst the Gonaqua (1781), they did not seem to remember their true origin.

The nature of the soil obliged the Hottentots to keep near the southern coast. Further north they would have come upon the great plain of the Karrou, which, from the want of water and good pasturage, would not have suited their cattle at all. So when Le Vaillant visited the Karrou, he found there no other population besides Bosjesmans and Souzouana. By this last name he designates also Bosjesmans, not Bechuanas.

While the Quaiquas occupied the most southern part of the country, they were in contact in the north with the Korannas. Le Vaillant met with the latter in their original station. But towards 1790 they emigrated towards the interior, and established themselves on the territory of the Transvaal, at the part where the Hart's River falls into the Vaal. The old chief, Mossou Ryt Taaibosh, stated, in 1872, to M. Burgers, who was then President of the Transvaal, that when he was about four-

teen (at the time of the declaration he was over a hundred) he had set out with his tribe, which had previously inhabited the coast.*

To the north of the Korannas, and to the north and south of the Orange river, dwelt the Namaquas. These people, visited for the first time by Van der Stell (1685), appear to have mixed with more northern tribes (not Hottentots), especially with the Damaras; so that the actual representatives of these latter would be partly their descendants. There exists, at least among the Damaras, a legend, according to which they had, as first ancestors, a Namaquan father and (*horribile dictu!*) an ape mother. This legend, which has been told me by hunters, is also spoken of by Wood.†

The Bosjesmans are at present sufficiently recognized as Hottentots. All the Hottentot tribes seem to have furnished their contingent to these pioneers. Nevertheless, there is room for thinking that, besides these deserters, they also comprise original tribes; and Le Vaillant even regards these as true and pure Hottentots. They penetrated further than all the others into the Karrou. They were not nomads, but they lived exclusively by hunting.

It was probably at a more distant period that the Bosjesmans (Sa-an or Sa-qua) separated from the other Hottentots. They feared the more northern tribes; as for those who lived more to the south, they seem to have known them but slightly or not at all.

We find on this subject the following curious passage, dated the 24th April, 1654, in the journal of Van Riebeek, the first governor of Cape Colony: 'To-day a dead *Bosmanneken* was found in the mountain, such as is called in Batavia an Ourang-outang. He was about the size of a small calf, with long and hairy arms and legs, and of a dark-grey colour. Forced by hunger, our people ate him.'‡ I must add, in defence of Van Riebeek, that at this time his relations with the neighbouring Hottentots were not at all friendly, so that he could not gain from them any enlightenment.

The Bosjesmans have always been driven back towards the interior of the country. Nowadays we meet with them nowhere but in the mountains of Basutoland, and in the plains of the Kalihari.

The Hottentots have never been a powerful people. According to the census of 1865 they numbered 81,600 in Cape Colony. Taking all the tribes together, I think we may estimate their total actual numbers at 270,000, perhaps at

* *Correspondence between Thom. Fr. Burgers and Sir Henry Barkly.*
† Wood, *Nat. Hist. of Man.*
‡ Hall, *Manual of South African Geography*, Chron. Tables.

300,000. It is possible that formerly they may have been more numerous, but the difference cannot have been great. They have never suffered very greatly from either war or epidemics. Moreover, considering the climate, the polygamy that was customary amongst them, etc., circumstances were favourable to their multiplication.

I think there is good reason for supposing that in 1500 their number was much smaller than at the present day. They had been unable, before the establishment of the Dutch Colony, to drive back the wild beasts, so dangerous to them and to their flocks. Lions, for instance, were still, in 1563, so numerous on the coast of Table Bay that Van Riebeek wrote in his journal, 'This night one would have said that the lions were inclined to take the fort by storm.'*

Though inhabiting the coast in 1500, and even later, they possessed no knowledge of navigation; so that they had no communication with Robben Island, which was situated opposite Table Bay.

The different tribes of Hottentots may be divided into, 1st, Quai-qua, or true Hottentots; 2nd, the Nama-qua; 3rd, the Koranna, Kora, or Kora-qua; 4th, Sa-an, Sa-qua, or Bosjesmans; 5th, Gonaqua and Gonaquebi—mixed races produced by a mixture of Caffres and Hottentots; 6th, Griqua, a mixed race, one issue of white fathers and Hottentot mothers. Hybrids of Hottentots and white women have never been noticed, as far as I know, and probably they do not exist.

The Griquas united about 1780–1790 into tribes, which abandoned the Cape Colony, and established themselves in the territory now forming the Vrystaat (Free State) and in Griqualand West. More recently, somewhere about 1850, many of the Griquas returned towards the coast in the district called Griqualand East, and formerly known by the name of Niemandsland (No-mans-land).

All the tribes, including the Gonaquas and the Griquas, belong by their physical characteristics and by their language to the same natural group. On the similarity of the language I must remark that the dialect of the Gonaquas is a mixture of the Caffre and Hottentot dialects, and that most of the Griquas speak Dutch.

The language of the Bosjesmans is the poorest of all; one might call it degenerated Hottentot. This fact is easily explained by the very primitive way of life of these pioneer hunters. An analogous example of degeneracy in language and physical characters may be observed now on the north-east borders of the Transvaal, among the Vaalpen Caffres, remnants of the great tribes of the Bechuanas, which have been exterminated

* Hall, *Manual of South African Geography*, Chron. Tables.

by more powerful neighbours. To these Vaalpens, the name of Bechuana-Bosjesmans might very well be given. A characteristic feature of the Hottentot dialect is the use of 'clics,' of which the Korannas particularly make very frequent use.

These dialects differ essentially from the Caffre dialects. Often, indeed, it has been believed (particularly in Cape Colony) that there existed a relationship between the two languages; and some even considered the Hottentot as a modified Caffre dialect. But this opinion is altogether erroneous. Before 1500 the Hottentots had seldom, if ever, come in contact with the Caffres.

The origin of the error in question is easy to discover. When the Hottentots entered into relations with the Caffres there resulted the mixed races of the Gonaquas and of the Gonaquebis, which both of them, and particularly the latter, spread among the Galeka Caffres. Thus the 'clics' and some Hottentot words were introduced into the language of the Galekas. But these 'clics' are only met among those Caffres who border on some Cape Colony, and among the Basutos (in greater part Bechuanas), who about 1830 constituted a distinct people and admitted among them some fugitive Hottentots.

Among the other Caffres, for example among those of Natal and Zululand, no trace either of the 'clics,' or of the other peculiarities of the Hottentot languages, are found. They are equally strangers to the language of the Bechuana, established to the north of the Transvaal.

For some time, however, the 'clics' appear to have a tendency to spread particularly in the south of Natal. As the Gonaquas also moved amongst the Hottentots several Caffre words have obtained a footing in the Hottentot language. The Korannas, after their immigration into the Transvaal frequently mingled with Bechuana tribes (black), and this has also diminished the purity of their language.

In Cape Colony many, if not most of the Hottentots, speak nothing but Dutch, and no longer know their original language. This language is still spoken only and exclusively by the Bosjesmans and the Namaquas. But these have likewise been in more and more frequent contact with the whites and other races. In fifty years their language will perhaps have entirely disappeared.

I have made some researches on the question of the distribution of the races at the Cape, a question which interested me especially. Its study is rendered very difficult by the very frequent change of abode of the different tribes, and as besides I have only incomplete materials at my disposal, the results obtained must be looked upon as merely tentative.

These results may be summed up as follows:—1. The central

part of the Cape countries, now known by the name of Karrou, as far as the Orange River, of Vrystaat, of Griqualand West, and of Kalihari, was formerly uninhabited and visited only by the Bosjesmans. From about 1790 the Vrystaat and Griqualand-West were colonized by Korannas and Griquas, and a little later by Bechuanas (Barolongs, Bawanketsis, &c.). The Korannas and the Griquas came from the Cape Colony, taking a direction from south to the north; the Bechuanas arrived from the north—probably from the northern part of the Transvaal.

2. The eastern part of the Cape, to the south of the Stormbergen, along the coast, and to the east of the Drakenbergen (which are a continuation of the Stormbergen), was already inhabited in 1500 by Caffres (British Caffraria, Natal, &c.).

3. The Transvaal was also early inhabited, particularly the northern part, by Bechuana tribes, who were always moving towards the south (1600 ?).

4. The country to the west of the Transvaal, which Livingstone and others have mentioned by the name of 'Sechele's Country,' was only colonized towards the year 1824 by Bechuana tribes (among which were the Makololos, who have since been moving again towards the north), which had been driven away from the Transvaal by the Matabeles of Moselekatse.

The Bechuanas and the Caffres seem to have come from more northern parts of Africa. They show a certain analogy of characters. Their movements were effected parallel to one another from the north to the south; the Caffres proceeding along the coasts, the Bechuanas across the central region. To the south of the Limpopo they were separated by the Drakenbergen, so that the Caffres remained to the east of this mountain range, and the Bechuanas to the west. Both these races are black, and we often find among them, especially among the Bechuanas, Arabian and Jewish types.

5. Basutoland, which was formerly entirely uninhabited, was colonized only in 1830 by Bechuana tribes coming from the Transvaal, and by a small number of Fetcannets (the present Fingoes of the Cape Colony, who before 1820 were Caffres of Natal), of Korannas, of Bosjesmans, &c., whom the chief Moshesh united into one people, under the name of Basutos (1830).

6. The country situated between the two rivers—the Limpopo and the Zambesi, to the north of the Transvaal—was originally occupied by Bechuanas, but later on, after 1836, it was invaded by Caffres—the Matabeles of Moselekatse, who left the Transvaal, and took a direction across Sechele's country, at first towards the west, afterwards towards the north, and still later towards the north-east. In the country of Moselekatse (or rather of his successor, Lo-bengula) some

missionaries (Merensky, &c.) have sought the Ophir and the Saba of the Old Testament. Maude has there discovered the grand ruins of Zimbaye.

The traces of human industry which I have found myself in the Transvaal belong to a rather recent date. Such are several old copper-mines (with quartzose gangues) in the Makhali mountains, a range of quartz porphyry, which, at about six English miles to the north of Pretoria, runs from the east to the west. Such are further old lead-mines, which I have found in the Waterberg district, about eighteen English miles to the north-east of the Nylstroom. Galena, rich in silver, is there disseminated in a vein of quartzite, which has been worked very methodically by open workings. Neither the Bechuanas nor the white population of the district knew by whom, or at what period, these works had been executed. I presume that they are to be ascribed to the Portuguese, who had very early taken footing in South Africa, and who followed trade.

The general conclusion from these researches is, that the Hottentots did not occupy the central part of the Cape. As the fertile plains of the Transvaal and of the Vrystaat were formerly uninhabited, they would have been able to live there quietly, just as well as elsewhere, if they had arrived in the south by this way.

I have reason to suppose that the south and the east of the Cape countries ought to be considered as their original abode. Thus we find, in the fifteenth century, in the southern part of the Cape, a *yellow* race, amounting to from 200,000 to 300,000 souls, bounded on the north by *black* tribes (Damara and Ovampo), and by desert places (Karrou, &c.), and in the east also by black tribes (Caffres).

[The author then makes a detailed comparison of the characters and measurements of Chinese and Hottentot skulls, the general results of which he sums up as follows:—]

If it is allowable to draw general conclusions from the measurement of so small a number of crania, we find:—

1. That the crania of the Hottentots are not only dolichocephalic, but in nearly half the cases (seven out of fifteen) orthocephalic. In general they are more dolichocephalic than the Chinese crania, the length being in them relatively greater, and the width less.

2. That the absolute height of the Hottentot crania is less than that of the Chinese crania. As the length of the first is relatively greater than that of the second, the index H. L. is smaller in the Hottentots.

3. That the Hottentots are in general less prognathous than the Chinese.

4. That the height of the face in the Hottentots is less than among the Chinese, the absolute height, as well as the relative (the index H. L.)

The points of resemblance between the Hottentots and the Chinese consist in—

1. The width of the bridge of the nose (space between the orbits).
2. The shape and inclination of the orbits.
3. The prominence of the zygomatic bones and arches.
4. The width of the face (taken at different heights).
5. The development of the parietal bosses.
6. The relation between the arcs and their chords.

This last character applies above all to the arcs and chords situated in the sagittal plane; in a less degree to the transverse arcs and chords.

If we consult the works of Blumenbach,* of Van der Hoeven,† of Lucae,‡ of Von Baer,§ of Retzius,‖ of Dusseau, of de Koning,¶ and others, we find indicated as fairly constant characters of the Chinese crania,—

1. A wide bridge to the nose, and a broad flat nose.
2. The facial surface of the upper jaw, but little hollowed, and often even convex (Dusseau).
3. The zygomatic bones and arches very prominent.
4. The parietal bosses well marked, and often very much developed.
5. A curvature with the convexity anterior of the alveolar part of the upper jaw; a curvature answered to by a similar one in the incisor teeth and their roots.

In all these respects the Hottentots resemble the Chinese, as also in the less constant character drawn from the height to which the bones of the nose ascend.

In both the vault of the cranium very often projects in the median line. In both we find, in most cases, elongated quadrilateral orbits, which incline outwards.

The projecting form and outward inclination of the angles of the lower jaw are frequently met with both in the Hottentots and in the Chinese. I must, however, admit that in the Chinese the nose is not so flat as it generally appears to be in the Hottentots. Immediately above the pyriform opening the nasal bones are more projecting in the former than in the latter. This difference was perceptible even in the Chinese and Hottentots whom I have seen alive. It follows from this

* *Decas collectionis*, Göttingen, 1790.
† *Tijdschrift v. nat. Geschied*, iii. p. 143. ‡ *Zur org. Formenlehre*, 1844.
§ *Mém. de l'Acad. de St. Petersbourg*, x. p. 241.
‖ *Ethnolog. Schriften*, 1864. ¶ *Catalogue du Musée Vrolik.*
** *Dissertatie*, Leyden, 1877.

that although the Chinese are in general platyrhinous, they are so in a less degree than the Hottentots.

In the second place, the convexity of the facial surface of the upper jaw is met with more frequently in the Hottentots than in the Chinese.

The peculiarity of having the angles of the lower jaw curved outwards, cannot be regarded as a race-character. I have met with it pretty frequently in the Caucasian crania of the Vrolik Museum. It must be noticed, moreover, that it exists principally in the crania of men. The crania of women—Hottentot, Chinese, and Caucasian alike—only show it rarely and in a very feeble degree.

M. de Koning has studied the anomalies of the sutures of the temporal region in the Chinese crania of the Leyden Museum, namely, the frontal apophysis of the squamous portion of the temporal and the sutural bones developed in the squamous suture which is situated towards the frontal bone. Similar relations, to which M. Virchow is inclined to attach an anthropological significance, were altogether wanting in the Hottentot crania which I have had the opportunity of seeing, nor do Messrs. Barnard Davis and Wyman (*loc. cit.*) mention them in the Hottentots examined by them.

In forty-one Caucasian crania in the Vrolik Museum, I have nine times found a sutural bone in the squamous suture, namely, eight times on one side only, and once (in the cranium of an Englishwoman) on both sides. Two of the Caucasian crania were stenocrotaphic. In none have I seen a true frontal apophysis of the squamous portion of the temporal.

The frequency of this sutural bone in the Caucasian crania of the Vrolik Museum is evidently quite a matter of chance. May not the frequency of the frontal apophysis of the squamous portion of the temporal of the Chinese studied by M. de Koning be in the same case?

I must here express my regret that I have not been able to study all that has been written about Hottentot crania. It is therefore very probable that I have neglected some important characters already noticed by other authors.

Van der Hoeven was of opinion that the analogy between the Hottentots and Chinese to which Barrow had called attention, only extended to the colour and the direction of the eyes.*

Although the similarity in colour and general appearance seems to me to be a fact of very great importance, I think that the cranial characters, in spite of certain differences, equally authorizes us to admit a close affinity between the Hottentots and Chinese.

* *Tijdschr. v. Nat. Geschied,* tome iii. p. 153.

To check the conclusions which I have found it necessary to adopt, it would be important to compare thoroughly the language, manners, customs, religion, legends, &c. of the two peoples. The facts which I have been able to collect on these heads are unfortunately but of little significance.

Dr. Carpenter, one of the few authors who admit the relationship between the Hottentots and the Mongols, having asked Mr. Norris whether there existed any analogy between the languages of the two races, received a reply in the affirmative: 'The affinities of the Hottentot language being rather connected, in his opinion, with the languages of High Asia, although the connecting links are extremely slight.' (Carpenter's *Human Physiology*, 5th Ed. p. 897.)

Prof. Schlegel, whom I have consulted on this subject, advised me not to place too much confidence in so vague an assertion, and said that in his opinion the affinity in question would be very difficult, if not impossible, to demonstrate.

Supposing, however, that there was no relationship between the two languages, it would still be no sufficient reason for denying the affinity between the races. The Chinese and the Japanese, who, in an anthropological sense, are closely allied, speak languages so different that there would be great difficulty in discovering the slightest analogy between them. The Ainos justify the same remark.

Moreover, the language of the Hottentots, in the course of centuries and under the influence of a number of circumstances, may have been considerably modified. It is certain, however, that in Africa it has undergone no considerable alteration, since, as I have already pointed out, it has remained fundamentally different from the languages of the neighbouring peoples.

As I had received from different sources, independent of each other and worthy of belief (among others from the present grand chief of the Korannas, Mossou Ryt Saaibosch), the communication of a legend, according to which the Korannas (and consequently also the other Hottentots) had arrived at the Cape in boats after traversing the sea, the idea struck me that some striking event in the history of the Chinese, or of other Asiatics, had occasioned an emigration. But to the questions which I put on this point to M. Schlegel, the reply was negative.

The Chinese in the fifteenth century only knew the eastern coast of Africa as far as Melinda (Dozy).

We must notice, also, that at a period already far distant, some Chinese, lost at sea, landed on the Isle of Bourbon, where their race is preserved to the present day, fairly pure (there were therefore women amongst them). M. Schlegel writes to me that, according to an oral communication of M. Grandidier,

these Chinese refer their arrival in Bourbon to the fifteenth or sixteenth century. A French half-caste, whom I met in the Diamond fields of South Africa, gave the date of their establishment still earlier.

The mythology of the Hottentots leaves us equally in obscurity. Old travellers, Kolbe amongst others, have described with much emphasis the religious ceremonies of the Hottentots. None of these accounts deserves the smallest confidence, any more than those of certain missionaries who believed they had made the same observations.

Le Vaillant, who of all the travellers to the Cape is most worthy of belief, and whose accounts are most exact and most provable, was unable to observe any trace of religion, either in the Korannas or in the Namaquas.

The later researches of M. Bleek on the mythology of the Bosjesmans do not further enlighten us on the subject. The legends and the myths collected by him all relate to the animals of Africa and to the stars of the southern sky. Most, if not all of them, are of very recent date. This is evident, among others, in the myth of the origin of the Moon, which M. Bleek regards—it is difficult to understand why—as among the most ancient. 'The Mantis threw one of her *shoes* at the Moon, which made it red (the Moon) because the red sand of the Bosjesmans' country adhered to the shoe, and cold because the shoe was only made of *leather. Thus the Moon is red because she was covered with the red dust of Bushmanland, and cold because it is only leather.*' (*Cape Monthly Magazine*, xi., 109.)

Now I must point out that the ancient Hottentots, although knowing since the sixteenth century how to tan skins, never wore shoes. Further, all the Bosjesmans whom I have seen were barefooted. The only *chaussure* which is found among them of ancient date (and not even generally) consisted of straps rolled round the lower part of the leg. As for shoes, the Bosjesmans knew nothing of them until they came in contact with the Europeans. The legend in question, then, must have been formed afterwards.

The first attempts at painting among the Bosjesmans are probably of an equally recent date. The reproductions which Wood gives of them in his *Natural History of Man*, suggest immediately the idea of badly-executed sketches of naval officers, recognizable among other things by the peculiar form of their hats. Some hunters assured me they had seen, in caves, early representations of animals.

All the Hottentots have a vivid imagination. They speak and sing willingly, but their recitals generally wander far from the truth. It is this which makes me look upon the information

collected by M. Bleek in his *Bushman's Researches*, as possessing a very problematical value.

A new indication may be furnished, I think, by their domestic animals. At the time of the discovery of the Cape the Hottentots possessed both sheep and oxen.

Sheep were originally entirely unknown to the Caffres and to the Bechuanas, as also, if I am not mistaken, to the Damaras and to the Ovampo.

The indigenous race of sheep of the Hottentots, which has at present, perhaps, entirely disappeared from the Cape countries, was the sheep with a big tail, identical, apparently, with the *Ovis platyura*. This *Ovis platyura*, from what I have heard from Mr. Horst, comes from the hot parts of Western Asia and the south of Russia, whence it has been imported into certain parts of Africa. The Hottentots were in possession of this sheep before the arrival of the Europeans; had they not brought it with them on leaving Asia? If the identity of the big-tailed sheep of the Cape with the *Ovis platyura* could be placed beyond doubt, it would be, in my opinion, a very important indication as to the question of the origin of the Hottentots.

The possession of this sheep-race proves still more. In the north of the Cape country we do not find any sheep. The middle part, including the northern Transvaal, seems entirely unfit for rearing these animals. Amongst the known causes we can quote the poisonous qualities of the pasturage, the presence of the *tsetsé* fly, and of special pneumonias. It would, therefore, have been difficult, if not impossible, for the Hottentots to move on from the North to the South on the firm soil of the Cape.

Cattle were reared by the Caffres and Bechuanas as well as the Hottentots. As to the Caffres, I believe that they possessed particular breeds of oxen (Zulu and Boeskop races); as to the Hottentots I have not been able to discover anything of the kind.

The Europeans got to know the Hottentots only at the end of the fifteenth century. As I have said already, the population of the Cape was then only thin. According to an estimate founded on the statements of travellers, I believe that the total of Hottentots at that period did not surpass 200,000. This number, which I should even feel inclined to reduce, is certainly only small for a people, which was, for a long series of centuries, in circumstances so favourable to its multiplication.

Moreover, it would be a very strange *lusus naturæ*, that could have produced at the Cape a race so characteristic, so different from all neighbouring people, and showing so much analogy with the Mongolian race.

REVIEWS.

ANIMAL LIFE.*

FEW naturalists can claim to speak with more authority than Prof. Semper. A long residence in those rich tropical Eastern countries, the natural productions of which we know chiefly from the descriptions of hurried travellers, or from the researches of scientific expeditions, familiarized him with the structure and habits of a most varied assemblage of animal forms; and his previous training enabled him to make good use of the unrivalled opportunities of study thus afforded him. Accordingly it is no great wonder that his volume of the 'International Science Series,' lately published, should be unquestionably one of the most interesting contributions to zoological literature that has appeared for years.

Holding the doctrine of the evolution of organic forms as proved, Prof. Semper considers that there has been sufficient theorizing on the subject, and that what we now require is an exact investigation, by observation and experiment, of the processes by which changes are produced in the organism. Thus he says in his Preface:—'The popular cant about "Biogenetic principles and the falsification of Ontogenesis—the laws of inheritance at corresponding periods of life, or the correlation of organs—Ontogeny and Phylogeny —variability and heredity"—is put out of court as useless; for these are merely axiomatic expressions for a sum of identical or correlative phenomena, of which the essential nature is in no way revealed by them;' and it is with the view of indicating the road which he thinks should be taken to furnish the true explanation of these generalized expressions that his present book was written.

Variability, he thinks, of all the properties of the organism 'is that which may first and most easily be traced by exact observation to its efficient causes;' and it is to the phenomena and causes of variation in animals that his book is chiefly devoted. But it has a further limitation. Prof. Semper is of opinion that the action of conditions external to the organism is a much more potent factor in the modification of the latter than is supposed by many naturalists of the so-called Darwinian school, or, in fact, by Mr. Darwin himself, at least in his earlier writings on the origin of species.

---

* *The Natural Conditions of Existence as they affect Animal Life.* By Karl Semper. 8vo. London: Kegan Paul & Co. 1881.

From this point of view the question of the variability of organisms is treated in a most thoughtful manner by Prof. Semper, and illustrated by the citation of a multitude of examples from all divisions of the animal kingdom, and in many cases founded on the personal observations of the author.

In the action of external conditions of existence upon animals, Prof. Semper distinguishes transforming and selective influences; but, in his arrangement of his subject, he divides the external agents into those belonging to inorganic or inanimate nature, including under this term the food which, although it may be derived from living organisms, does not become food until after they are dead; and those due to living organisms, and especially to living animals of other species. Both these series include both transforming and selective influences.

Under the former category we have, besides food already mentioned, the influence of light and temperature, that of the condition of the water upon aquatic animals, and of the air upon others, the influence of currents upon the distribution of animals, and some other points; under the second, the action of parasites and hybridization indirectly transforming animals, and the consequences of the competition among animals in its selective influence on the organisms. In connexion with the influence of water in motion, Prof. Semper furnishes his readers with an exposition of his views on the formation of coral reefs, illustrated especially by his own investigations on the Pelew Islands, which, as is well known, have led him, in opposition to the generally received views of Mr. Darwin, to the opinion that here, at any rate, the evidence is in favour of the occurrence of upheaval of the region during the formation of the reef. So far as the Pelew Islands are concerned, there is no doubt the author makes out a very strong case; but whether it is an exceptional one remains to be seen. Under any circumstances, his description of the Pelew reefs will be read with much interest.

Throughout his little book, indeed, the amount of interesting information on the structure and habits of animals that Prof. Semper lays before his readers is very great; and the statements in the text are supplemented by a series of most valuable notes on points of detail, forming an appendix. The book is very freely illustrated with well-executed woodcuts, and is certainly one of the most attractive volumes on natural history that has appeared for several years.

A POLAR RECONNAISSANCE.*

THIS most interesting book is intended by Captain Markham not only as an account of a voyage made by him in company with Sir H. Gore Booth to the seas surrounding Novaya Zemlya, but also as an argument in

---

* *A Polar Reconnaissance, being the Voyage of the 'Isbjörn' to Novaya Zemlya in* 1879. By Albert H. Markham. 8vo. London: C. Kegan Paul & Co., 1881.

favour of renewed exploration in the Arctic regions, and as an indication of the direction in which he thinks future attempts to reach the North Pole should be made. In furtherance of his general design he prefaces the description of his own voyage with a historical account of the progress of discovery in the region of Novaya Zemlya, which, brief as it necessarily is, contains an exceedingly interesting record of a long series of most gallant attempts to enlarge the knowledge of the geography of these inhospitable regions.

As regards the exploration of the region around the Pole itself, Captain Markham is of opinion that the most hopeful direction for further research is along the west coast of the land discovered by the Austrian expedition under Weyprecht and Payer in 1872, and named by them, in honour of their Emperor, Franz Josef Land. The records of former voyages, and Captain Markham's own experience in the *Isbjörn*, would seem to show that in August and September in ordinary seasons there would be no difficulty in reaching and exploring Franz Josef Land in a steamer; and as the southernmost point of that land is beyond 80° N. lat., it would certainly seem that in this direction we may with little trouble or delay attain a proximity to the Pole which was only reached with considerable expenditure of time and labour in our last expedition through Smith's Sound.

The *Isbjörn*, in which Captain Markham and his companion visited Novaya Zemlya and pushed a considerable distance further towards the north, was a little cutter of 43 tons burthen built for Arctic purposes in 1870, and employed by the Austrian explorers, Weyprecht and Payer, in making a reconnaissance preliminary to their voyage in the *Tegetthof*. The description of the accommodations on board this little craft, and especially of the *désagrémens* caused by the dirty and untidy habits of their Norwegian sailors, is by no means attractive; nevertheless, the boat, small as it was, seems to have been admirably fitted for the purpose, although apparently rather too 'lively' in a rough sea to be quite agreeable even to a captain in the British Navy.

The travellers embarked at Tromsö on May 18th, reached Novaya Zemlya on the 9th June, and remained about the shores of that island until the 5th September. They were prevented from navigating the Kara Sea by the presence of ice and the exaggerated idea of the danger involved in encountering it entertained by the crew of their little vessel, especially two harpooners, who were regarded as *ex officio* authorities on the subject of ice-navigation, and who appear to have been rather pusillanimous when brought into contact with ice in any shape. Accordingly, when the *Isbjörn* quitted the northern extremity of Novaya Zemlya, her course was taken in a north-westerly direction, with the intention of bearing up towards Franz Josef Land, but ice was again met with about 78° N. lat. and the fears of the crew were again excited, although this time apparently with more reason, as Captain Markham himself seems to have come to the conclusion that there was pack-ice in front of them. On the 12th September, in the midst of ice and with foggy and rough weather, the travellers reached their most northern point in 78° 24′ N. lat., or within about 100 miles of the southernmost part of Franz Josef Land; but here the danger of being caught in the ice in so small a vessel and with only a month's provisions on board made a quick retreat the most

prudent course that could be adopted, and they sailed in a south-westerly direction to regain Tromsö, where they arrived on the 22nd. Another sailing vessel, the Dutch schooner *Willem Barents*, under the command of Captain de Bruyne, was engaged in an exploration of these seas at the same time as the *Isbjörn*, but was more fortunate, for she met with no ice of consequence on her way to Franz Josef Land, which she sighted on the 7th September.

Captain Markham's narrative of the events of the voyage is very pleasantly given, and as the greater part of the time was passed off the shores of Novaya Zemlya, upon which the travellers landed frequently, we get from him a very good account of the scenery of the islands, which is illustrated by several very well-executed woodcuts. Much attention was paid to the natural history of the districts visited, and Captain Markham not only records his observations upon the habits of various animals, especially some of the sea-birds; but he made considerable collections both of animals and plants which have enabled him to add considerably to our knowledge of the fauna and flora of Novaya Zemlya. Special reports on these collections by several distinguished naturalists are given in the form of appendices at the end of the book, which, from all points of view, must be regarded as an important contribution to the literature of Arctic exploration.

HELMHOLTZ'S LECTURES.*

PROF. HELMHOLTZ'S reputation stands upon a tripod. It rests, first and foremost, upon his originality as a physicist; then upon his mathematical powers; and, thirdly, upon his contributions to physiological science. Rarely has a man of such versatility exhibited the profundity of knowledge which Prof. Helmholtz has reached in each of these pursuits. Whether we view him as physicist, as mathematician, or as physiologist, we are equally constrained to admire the rarity of his genius.

The work which is now before us contains essays bearing upon each of his favourite studies, and therefore, though small, it will appeal to a variety of readers. The mathematician will instinctively open the volume at the lecture 'On the Origin and Significance of Geometrical Axioms;' the medical man will unfailingly turn to the address entitled 'Thought in Medicine;' while the student of physics will natually read the *éloge* on Gustav Magnus, or the lectures 'On the Relation of Optics to Painting,' or the discourse 'On the Origin of the Planetary System.'

But these Lectures are not addressed exclusively, or even mainly, to specialists; they are, as the title indicates, emphatically 'popular.' When Ancient Pistol asks the king, 'Art thou base, common, and *popular?*' he uses the word as a derogatory expression. But these Lectures are popular

---

* *Popular Lectures on Scientific Subjects.* By H. Helmholtz, Professor of Physics in the University of Berlin. Translated by E. Atkinson, Ph.D., F.C.S. Second Series. 8vo. London: Longmans, Green, & Co., 1881.

in the very best sense of the word:—the science is popularized without being vulgarized; the lectures may readily be 'understanded of the people,' while they still retain the true ring of sound science. In fine, they are essays which may be read with relish by every man of culture, whether scientific or not.

It is to be regretted, however, that some of the lectures published in this volume have grown rather old, and have thus lost the edge of their interest. Thus the opening discourse on Magnus was delivered as far back as ten years ago! Dr. Atkinson, the accomplished translator of the Essays, has wisely introduced considerable modifications into the last lecture, dealing with 'Academic Freedom in German Universities;' a lecture which, in its original form, contained remarks on the Universities of Oxford and Cambridge that could hardly be reproduced at this time in England, and certainly would not reflect the present position of education at those centres. Let us hope that Prof. Helmholtz's second series of Popular Scientific Lectures will be as well received by English readers as were the first.

NATURE'S HYGIENE.*

IT is a general belief that the vicinity of a pine-forest is exceptionally healthy, and of late years the *Eucalyptus* has also been credited with sanitary properties of a very marked character. Mr. Kingzett addressed himself some time ago to the chemistry of the subject, in order to explain, if possible, the hygienic influence of these trees. His researches lead him to attribute their influence to the presence of certain essential oils, which, by their slow oxidation, exert a purifying action upon any malarious exhalations. Under the influence of air and moisture, the volatile oils of the *Eucalyptus* and of the pine are oxidized, yielding peroxide of hydrogen—a powerful disinfectant—and camphoric acid, which is antiseptic. The oil of turpentine has, apparently, a higher oxidizing power than the oil of eucalyptus, and hence pines are especially efficacious in rendering a locality salubrious.

Mr. Kingzett's studies have led him to prepare an artificial substance which he terms 'Sanitas;' but a review of a scientific work must not become a medium for advertizing a new disinfectant. Suffice it to say, then, that Mr. Kingzett's researches in *Nature's Hygiene* are so clearly put before the public in the present work as to be quite intelligible even to those who are not versed in chemical lore.

---

* *Nature's Hygiene: A Series of Essays on Popular Scientific Subjects, with special reference to the Chemistry and Hygiene of the Eucalyptus and the Pine.* By C. T. Kingzett, F.C.S. 8vo. London: Baillière, Tindall and Cox. 1880.

PHYSIOLOGICAL CHEMISTRY.*

MEDICAL students have undoubtedly been hitherto at a loss for a handy book of physiological chemistry. True we may point to the fine treatise of Klein, Foster, Burdon-Sanderson, and Brunton; but few indeed are the students who have time to read and digest so elaborate a work. What most students require is a neat and compendious book which will serve as a guide in the physiological laboratory and will give them sufficient grasp of the subject to enable them to meet the examiner. It is not, now-a-days, enough to have 'read up' the subject in a text-book, but the student must show that he has actually seen and handled what he reads about; he must prepare tissues for microscopic examination; he must test the proximate principles of the body; he must demonstrate the chemical composition and the characteristic reactions of the various constituents of the tissues and of the nutritive fluids. How is all this knowledge to be acquired in a limited time? Books on histology there certainly are; but where can the student learn in small compass the pure chemistry of his subject? This is the want which Dr. Ralfe has set himself to supply, and we believe that the little work which he has produced is, in every way, fitted for its purpose. The instructions seem to be clear, concise, and trustworthy; and every student in a physiological laboratory will find it useful to have it at his elbow.

THE CONSTITUTION OF THE EARTH.†

MR. WARD, when a young man of two-and-twenty, favoured the world with a modest essay, in which he enunciated his views on the constitution of the Earth. The leading object of the writer was to show that the Earth had derived its existence from the Sun, and had been, and still was, slowly increasing in size: not by mechanical action, but by a physiological process analogous to the growth of an organic body. Six-and-thirty years have passed since that essay appeared, and science has meanwhile advanced with unexpected rapidity. Nevertheless Mr. Ward believes that the march of science has only strengthened his position. Soon after the publication of his essay there appeared the *Vestiges of Creation*, and at a much later period *The Origin of Species*. But Mr. Ward had forestalled the writers of these works, and had convinced himself of the transmutability of species; only he had his own way of explaining the operations of the laws of development. The present work is but an expansion of the earlier essay. It is not likely that Mr. Ward will secure a large number of adherents to his peculiar view that the Earth

---

* *Demonstrations in Physiological and Pathological Chemistry; with a Concise Account of the Clinical Examination of Urine.* By Charles Henry Ralfe, M.A., M.D. (Cantab.), F.R.C.P., &c. 8vo. London: David Bogue. 1880.

† *The Constitution of the Earth; being an Interpretation of the Laws of God in Nature, by which the Earth and its organic life have been derived from the Sun by a progressive development.* By Robert Ward. 8vo. London: George Bell and Sons. 1880.

is growing larger by a kind of vital action; nor do we think that he will do much to stem the current of scientific scepticism which has disturbed his peace of mind. The astronomer, not less than the geologist, will have many a bone of contention to fight over with Mr. Ward.

STEAM AND THE STEAM-ENGINE.*

ACCORDING to the title-page of the new edition of Dr. Evers's *Steam*, the work has now reached its twenty-sixth thousand. We may therefore take it that in the keen struggle for existence among the many text-books which crowd the market, Dr. Evers's work has shown healthy vitality, and has asserted its right to live and to take rank among our standard manuals. At the time of its first appearance there was no work of its kind —at once comprehensive and cheap—and Dr. Evers supplied a want which had been felt, especially by classes working in connexion with the Science and Art Department. Primarily intended for use in such classes, it by no means servilely follows the Syllabus of the Examinations, and certainly stands above a cram-book for use in preparing for the May ordeal. The new edition has been revised, and has received the benefit of an additional chapter on compound engines.

EXTINCT BRITISH ANIMALS.†

MR. HARTING opens the introduction to his treatise on recently extinguished British Mammals in the following words:—'The interest which attaches to the history of extinct British animals can only be equalled by the regret which must be felt by all true naturalists at their disappearance beyond recall from our fauna. It is a curious reflection at the present day, as we pass over some of the wilder parts of the country, that at one time these same moors, and woods, and glens, which we now traverse so securely, were infested to such an extent with ferocious animals, that a journey of any length was, on this account, attended with considerable danger.' It needs the spirit of the true naturalist to regret the change that has taken place.

Either as naturalist or sportsman, however, Mr. Harting revels in the ideas thus conjured up. His imagination brings before him scenes which, to

---

* *Steam and the Steam-Engine; Land, Marine, and Locomotive.* By Henry Evers, LL.D. (*Collins' Advanced Science Series*). 8vo. London: W. Collins and Sons. 1880.

† *British Animals extinct within Historic Times, with some accounts of British Wild White Cattle.* By James Edward Harting. 8vo. London: Trübner & Co., 1880.

ordinary mortals, may seem unattractive enough, but upon which he dwells with sentimental yearnings. 'Packs of wolves,' he says, 'which usually issued forth at night to ravage the herdsman's flocks, were ever ready to attack the solitary herdsman, or unwary traveller on foot, who might venture to pass within reach of their hiding-places. In the oak woods and amongst the reed-beds which fringed the meres, wild boars lurked . . . . . Many a traveller then had cause to rue the sudden and unexpected rush of some grand old patriarch of the "sownder," who, with gnashing tusks, charged out upon the invader of his domain, occasionally unhorsing him, and not unfrequently inflicting severe injuries upon his steed.'

Degenerate Britons of the present day may, perhaps, be glad to compound for the absence of such wild beasts as the wolf, the bear, and the wild boar, by their freedom from the chance of finding any such excitements as the above when journeying from town to town on foot or on horseback; but the enthusiasm that prompts the author of this book to express his regret that the wild beasts, with all their inconvenient habits, have passed away from our country, may serve to give the reader an assurance that no pains have been spared by him in its preparation. It is difficult, as he justly says, to realize the state of things above indicated, 'unless we consider at the same time the aspect and condition of the country in which these animals lived, and the remarkable physical changes which have since taken place.' Half the country, at least, was forest, or wild, uncultivated ground, and in the disappearance of this state of things the naturalist can hardly avoid finding some cause of regret, hundreds of organisms, both animal and vegetable, must have succumbed to the progress of cultivation and the spread of population, which have now attained such a pitch that one has to travel a considerable distance from London, at any rate, in order to find a bit of undisturbed land. How different from the condition of things some six or seven centuries ago, when the forests came up almost to the gates of London, and the churches in certain cities lighted beacons on their towers to guide belated travellers through the waste outside.

Five mammals, which have become extinct in Britain within the historical period, are here recorded by Mr. Harting, namely, the Bear, the Beaver, the Reindeer, the Wild Boar, and the Wolf. On the last-named animal Mr. Harting contributed a long article to this *Review* some years ago. It is treated here very much in the same manner, but with considerable additional information. The Bear, as a British animal, does not seem to have been abundant in the southern parts of the country within historic times; but there is no doubt that it existed in England and Wales at least as late as the middle of the eighth century. In Scotland it seems to have survived till the tenth century. Its presence in Ireland as a native animal is doubtful, except from fossil evidence. The Beaver, remains of which are not very uncommon in peaty soils in the fenlands and elsewhere in England, seems to have survived till the end of the twelfth century in Wales, and to a much later period in Scotland. In the latter country there is somewhat doubtful testimony to its occurrence as late as the sixteenth century. The historical evidence of the existence of the Reindeer in Britain is still more scanty, and rests principally upon a statement in an Icelandic Saga to the effect that the Jarls of Orkney were in the habit of crossing to Caithness in the summer to hunt

this animal and the red deer—a statement the preciseness of which is rendered doubtful by the use in the original Saga of a conjunction of variable meaning, which leaves it uncertain whether the writer was referring to two animals, or using what he thought were two names for the same. The Wild Boar seems to have survived until well on in the seventeenth century.

Besides these animals, which have become absolutely extinct in this country, Mr. Harting has a chapter on the so-called wild white cattle, generally supposed to represent the original wild cattle of these islands (*Bos primigenius*). Like the Aurochs or European Bison, these cattle may fairly be regarded as extinct as wild animals, seeing that their only representatives are to be found preserved in certain parks in various parts of the country.

The subjects here discussed are of great interest; and Mr. Harting has spared no labour in endeavouring to do justice to them. Old deeds, books of all kinds, law reports, and the most miscellaneous sources have been ransacked by him in search of information upon these former denizens of our islands; and the result is that he has brought together, in a most readable form, a mass of very curious information, old and recent, of special interest to the zoologist, but which may be perused with pleasure even by those who are not naturalists.

THE CHRISTIAN KNOWLEDGE SOCIETY.

THE Committee of the Society for Promoting Christian Knowledge seem inclined to hold very broad views as to what may be called 'Christian Knowledge.' Their theory, no doubt, is that the cultivated Christian ought not to be behind other people in general knowledge, and in this we think they are quite right. We have already had occasion to notice one or two popular works on scientific subjects: such as Prof. Duncan's little seaside book, and the late Prof. Ansted's elementary treatise on Minerals; and we have now received from the Society a parcel of books, to which we may call the reader's attention, although some of them have no claim to a strictly scientific character.

This applies more especially to two volumes by Mr. Davenport Adams, entitled *Wrecked Lives, or Men who have failed*, in which the author has given some account of the lives of several more or less prominent or distinguished men, who, like the boy who didn't care, came to a bad or unsatisfactory end. Another work, by the same author, describes the doings of a select band of travellers, commencing with Marco Polo, and winding up with Major Burnaby and Sir Samuel Baker. This little book* will be read with interest; it gives a good popular account of some of the more important journeys made in various parts of the world. Mr. Eden's volume on Africa†

---

* *Some Heroes of Travel; or Chapters from the History of Geographical Discovery and Enterprise.* By W. H. Davenport Adams. Sm. 8vo. London, 1880.

† *Africa, seen through its Explorers.* By C. H. Eden. Sm. 8vo. London.

gives a good popular history of the progress of discovery on the African continent, embracing the labours of Bruce, Park, and his successors Denham, Clapperton, and Lander, Du Chaillu and Schweinfurth, and finally Livingstone. The book concludes with Livingstone's last expedition. It is illustrated with a small folding map of Africa and some tolerably good woodcuts.

Two other little volumes, although not upon what are generally considered scientific matters, may nevertheless possess considerable interest for the readers of this *Review*. They are treatises upon the two great ancient systems of philosophy,—Stoicism and Epicureanism.* Both these little books appear to be exceedingly well executed, and the subjects are handled in a free and philosophical spirit. We may remark, especially in connexion with these works, where it might have been looked for, the entire absence of any obtrusive Christian pietism. The authors seem throughout to seek to recognize what is good in these ancient philosophies, and to lay before their readers a candid statement of the historical facts.

In Dr. Goodwin's treatise on the *Origin of the World according to Revelation and Science*,† we certainly seem to see some traces here and there of the *odium theologicum*, and we do not think the author has done very much towards clearing up the difficulties of the case. He evidently does not clearly realize what is meant by origin of species by evolution. The key to his idea is that the account of the creation in Genesis is to some extent poetical, but especially moral and didactic, the description of the creation of animals and plants being merely the framework for the picture of the creation of man to which they in a manner lead up.

The first of a series of shilling *Manuals of Elementary Science*‡ is on Electricity, and by Prof. Fleeming Jenkin. It is necessarily a very brief exposition of the principles of the science; but it seems to be very clearly written, and to touch upon all the more important points.

We have kept to the last the most pretentious of the volumes that we have received from the Society; not, however, for the ordinary reason that it is the best, but from directly opposite considerations. It is called a *Natural History of British Fishes*, by the late Frank Buckland,‖ and but for the melancholy circumstances under which it has been produced, we should have felt bound to handle it pretty severely. As a *Natural History of British Fishes* it is lamentably defective, the author's well-known want of scientific knowledge, and ignorance or disregard of what other people have done, being conspicuously shown in nearly every page; and the book may be defined as little more than a pretty lively narrative of Mr. Frank Buckland's experiences in the pursuit of ichthyological knowledge by the light of his own

---

* *Stoicism*. By the Rev. W. W. Capes.—*Epicureanism*. By William Wallace. Sm. 8vo. London, 1880.

† *The Origin of the World according to Revelation and Science*. A Lecture by Harvey Goodwin, D.D. Sm. 8vo. London, 1880.

‡ *Electricity*. By Fleeming Jenkin. Sm. 8vo. London, 1880.

‖ *Natural History of British Fishes; their Structure, Economic Uses, and Capture by Net and Rod. Cultivation of Fish Ponds. Fish suited for Acclimatisation. Artificial Breeding of Salmon*. By Frank Buckland. 8vo. London, 1881.

intellectual lanthorn. It contains, however, some interesting details upon fisheries; and the practical appendix on fishponds, the acclimatization of fish, and the artificial breeding of salmon, may prove useful. The account of the salmon is also the best section in the body of the work. The woodcuts with which it is illustrated are for the most part indifferent.

PLANT LIFE.*

WE do not know why the author of this little work has thought proper to publish it anonymously. He has certainly no occasion to conceal his name, for the series of chapters on Botanical subjects, which he has here brought together, show a sound knowledge of the science, and very considerable power of communicating that knowledge in a pleasing and interesting manner. The book does not profess to be a systematic treatise on Botany, but a good method runs through the seemingly desultory chapters; and the general facts of the history of plants will be found to be well described in them. The author commences with microscopic plants, and then describes the structure and growth of plants, and the mode of fertilization of flowers. Ferns occupy another chapter, and others are devoted to the lower groups of Cryptogamia. Recent researches are referred to, such as those of Mr. Darwin and others on predatory plants, on the fertilization of Orchids, and on polymorphism. Interspersed with these are good chapters on the folk-lore of plants, on plants and animals, and on plants and planets, the latter an exceedingly amusing and well-written exposition of some of the absurdities of the old astrological herbalists. On the whole we have seldom seen a book better adapted to inspire unscientific readers with taste for the study of a science. With the view probably of assisting those who may be induced by his more popular book to commence botanical investigations, the same author has published some *Easy Lessons in Botany*,† which seem exceedingly well fitted for the above purpose. What 'the requirements of the Revised Code, 1880,' may be we don't know; but the little book is said to be written to fulfil them. Both these books are nicely illustrated with numerous woodcut figures drawn by the author.

MOVEMENTS OF PLANTS.‡

MR. DARWIN in this work investigates and discusses, after his usual thoroughgoing fashion, a series of phenomena of movement displayed

---

* *Plant-life: Popular Papers on the Phenomena of Botany.* With 148 illustrations drawn by the author. Sm. 8vo. London: Marshall Japp & Co. 1881.

† *Easy Lessons in Botany.* By the author of *Plant Life.* Sm. 8vo. London: Marshall Japp & Co. 1881.

‡ *The Power of Movement in Plants.*—By Charles Darwin, LL.D., F.R.S. Assisted by Francis Darwin. 8vo. London: John Murray, 1880.

by plants, to which he gives the general name of 'circumnutation.' This term is employed to express the tendency of the different parts of plants in growth, to describe a series of irregular curves, loops, and zig-zags, by their movements successively towards all points of the compass. As we propose in the next number to have an article explanatory of Mr. Darwin's views. we shall not attempt to discuss them in the space at our disposal here, The experiments recorded are of the most ingenious kind, and carried out with the utmost care, and with that attention to all minutiæ which Mr. Darwin so well knows how to bestow upon the most complicated investigations. Hundreds of figures, showing the tracks made by growing plumules and radicles, are reproduced in woodcuts, and we think that on inspecting them the reader will be rather surprised to find that Mr. Darwin has been able to evolve anything definite from such an apparent chaos.

SCIENTIFIC SUMMARY.

ANTHROPOLOGY.

Quaternary Human Remains at Nice.—On the 21st March some reports upon the occurrence of human remains in an undisturbed deposit at Nice were laid before the French Academy (see *Comptes Rendus* of the above date). M. Desor described the geological structure of the ground, which had at the surface 1¼ metre of vegetable soil, followed by 1·93 M. of tufaceous calcareous mud, overlying about 1 metre of siliceous sand, with intermixed Pliocene and Eocene fossils, beneath which were 2 metres of gravel, more or less conglomerated, surmounting a compact conglomerate. The bones were found in the calcareous deposit at an altitude of from 25 to 30 metres above the bottom of the surrounding valleys. There is no trace of disturbance or irregularity around the cavity from which the remains were extracted, and all the characters of the deposit show that there can be no question of inhumation. The portions of skeleton obtained were found 0·58 M. above the bottom of the deposit. The stratification is in all directions, and would seem to indicate torrential action, so common in quaternary times; the human skeleton was probably conveyed to the position where it was found by a current. The deposit must have been formed at a period when the shore was lower than at present, when the Paillon and the other water-courses of the coast spread over the Tertiary plateaux before they had hollowed out their present beds. The deposit is thus one of the diluvial formations contemporaneous with the erosion of the Tertiary plateaux.

The human remains found, as determined by Dr. Niepce, consist of the following bones:—Part of the lower jaw, including the left and part of the right ramus, and containing the four last molars well preserved. The alveoli of the teeth are vertical, with no trace of prognathism. The left ramus measures 11 centim. from the angle to the symphysis; and the distance between the two branches is 95 millim. The teeth are scarcely at all worn, and the last molar is as large as the rest.

The other bones are a fragment of the middle of the femur, fragments of the left tibia, a fragment of the left humerus, a fragment of the radius, and a fragment probably of the clavicle. From the examination of these portions Dr. Niepce arrives at the conclusion that the bones probably belonged to a small person not less than thirty years old, probably a woman.

M. de Quatrefages goes into the question of race, for the determination of which the materials do not seem very sufficient. He finds, however, that

the jaw strikingly resembles that found in the caves of Engihoul near Liége in 1860, which, from additional evidence was referred by M. Hamy to the race of Cro-Magnon, and this identification would lead to the Nice jaw being referred to the same race, along with the skeletons obtained by M. Rivière near Mentone. M. de Quatrefages finds this identification supported by two fragments of bone which he refers to the right femur, and which strikingly present the strong longitudinal projection (*linea aspera*) which is characteristic of the men of Cro-Magnon. This race consequently lived in the Quaternary period both on the shores of Nice and among the mountains of Périgord.

ASTRONOMY.

The real Libration of the Moon.—It has long been suspected that from its slightly ellipsoidal figure, the Moon undergoes a real libration, or slight periodical inequality, in its otherwise uniform rotation on its axis. Several attempts have been made to determine the amount of this real libration, but without any great success, though it is known that it must follow certain well-ascertained theoretical laws. Indeed, the theory of gravitation enables us to calculate the theory of this real libration with all desired accuracy, it only remains for observation to determine what is its actual maximum amount; for this depending on the actual figure of the Moon is outside the domain of theory, and appertains strictly to observation.

Lately, Herr Dr. Hartwig, of the Strassburg Observatory, has made an important addition to our knowledge of this subject by an elaborate memoir entitled, *Beitrag zur Bestimmung der Physischen Libration des Mondes.* He has employed, as the foundation of his investigation, forty-two measures, by means of the Strassburg heliometer, of the distance of the crater Mosting A, from seven points in the limb of the Moon. These measures Herr Hartwig proceeds to reduce in practically the same manner as employed by Herr Wichmann in his famous investigation of the year 1847, using exactly the same theoretical basis. The main results obtained by Herr Hartwig, and those previously obtained by Herr Wichmann, are appended:—

	Wichmann.	Hartwig.
Latitude of Mosting A . .	$= -3^\circ\ 10'\ 21'' \pm 11''$	$= -3^\circ\ 10'\ 55'' \pm 24''$
Longitude of Mosting A .	$= -5\ 10\ 57 \pm 25$	$= -5\ 13\ 23 \pm 89$
Inclination of the lunar equator to the ecliptic . .	$= 1\ 36\ 34 \pm 113$	$= 1\ 39\ 9 \pm 250$

So far the results are not very discordant, and the small probable errors indicate the superior trustworthiness of Herr Hartwig's results. The effects for the real libration may be written as follows:—

Real libration in latitude . $= +17'' \sin\{13^\circ{\cdot}188\,T + 80^\circ\}$ according to Wichmann.

$= +295 \sin\{13^\circ{\cdot}188\,T + 80^\circ\}$ according to Hartwig.

Real libration in longitude = $+ 178 \sin \{ 0{\cdot}480\,T \}$
$+ 150 \sin \mu - 24'' \sin \alpha$, according to Wichmann.
$+ 61 \sin \{ 0{\cdot}396\,T + 90° \}$
$+ 124 \sin \mu - 21'' \sin \alpha$, according to Hartwig.*

It will be seen that these results are very far from being as accordant as they ought to be, and show that there have been grave systematic errors in one, or both, of the two series of observations or reductions. It is much to be desired that a reduction should be made of a great number of observations made by Herr Schlüter in 1841–44, and it would be desirable to have Herr Hartwig's results reduced with values for the arguments derived from his own observations, and not from those of Wichmann.

Prof. Pritchard, of the Oxford Observatory, is also reducing a number of measures of photographs of the Moon, with the view of determining the real libration. His results are not yet published, but he has stated that they are in accord with those found by Wichmann. In a recent communication to the Royal Astronomical Society, Prof. Pritchard speaks rather despondently of the prospects of determining the actual amount of this real libration. Quoting from an account of his remarks at the Society (*Observatory*, February 1881), he says: 'We must accept this—that these measures and these calculations, though beyond all doubt they show that there really is a lunar physical libration, and that it is somewhere between these numbers, yet you will never get it within 20 or 30 or 40 seconds.' But there are far superior methods for determining this real libration than have ever been employed as yet; and so far from accepting the gloomy view taken by Prof. Pritchard, it is probable that astronomers will look to one of these improved methods to reduce the uncertainty to far smaller limit than supposed by Prof. Pritchard. It may be here mentioned that 20 to 40 seconds of selenographical longitude corresponds at the mean distance of the Moon to only one to two tenths of a second of arc; a small enough quantity.

The Diameter of Mars.—Lately (*Monthly Notices R.A.S.* Nov. 1880) Mr. Downing has determined, from some five hundred measures with the Greenwich Transit Circle, the mean diameter of the planet *Mars*, which he finds to be—

$$= 9''{\cdot}697 \pm 0''{\cdot}107$$

He also finds that there is a constant correction required for irradiation, which is equal to—

$$= + 2''{\cdot}369 \pm 0''{\cdot}175$$

As Mr. Downing points out, the correction is unusually large, that for the Washington 4-inch Mural Circle being only $1''{\cdot}192$.

Mr. Stone, F.R.S., has also lately made a communication to the Astronomical Society on the same subject. He finds that different observers have a considerable personality in observing the diameter of the planets, some

* In these formulæ, T = the number of mean solar days for January 1, 1845; μ denotes the mean anomaly of the Sun; and α, the mean anomaly of the Moon.

making it systematically larger than others. Thus Mr. Ellis's personal equation amounted to + 1″·10, whereas Mr. Dunkin's was – 0″·68, so that Mr. Ellis systematically makes the diameter of *Mars* 1″·78 larger than Mr. Dunkin. A further result was also ascertained, namely, that the diameter was systematically made too large when the planet is at a considerable distance from the Earth. Lastly, Mr. Stone considers that the large irradiation constant obtained by Mr. Downing is fictitious to a certain extent, and due to other causes.

The Diameter of Vesta.—Last year, from a numerous set of measures, Prof. Tacchini of Rome determined the apparent diameter of this minor planet to be—

$$= 1''{\cdot}706 \pm 0''{\cdot}09.$$

Since then another set of measures has been obtained by his colleague, Prof. Millosevich, who finds the diameter to be—

$$= 1''{\cdot}655 \pm 0''{\cdot}09.$$

These results, freed from the effect of irradiation, would give about 800 miles for the diameter of this planet.

Jupiter.—Further interesting observations have been made by different observers of the changes which are taking place in the cloud strata of this giant planet. The white spots on the equatorial belt continue to remain visible, but are becoming more irregular in form and dimensions; their edges, too, are becoming softer and less sharply defined. They continue to move much faster than the great red spot, which still continues visible, but has lost much of the vividness of its tint; and Mr. Denning has watched one gain a whole revolution of the planet on the red spot. The band of dark irregular spots on the northern equatorial belt continued to be visible during the winter, but they have changed very considerably in form and appearance, rendering it difficult to accurately determine the period of their rotation. They seem now to move faster than the white spots, though originally Schmidt and some other observers considered their motion to be slower. The greyish belt north of this belt of blackish spots has grown thicker and darker of late, and still further north there are signs of a new belt. Mr. W. F. Denning thus sums up the results of his winter observations (*Observatory*, March 1881):

'It is to be noted that the recent observations of this planet have revealed, in the clearest manner possible, a quadruple series of spot-motions. There is the red spot with its period of $9^h\ 55^m\ 34^s$; the short, dusky streaks (south on the red spot in the southern hemisphere) with their approximate line of $9^h\ 55\frac{1}{4}^m$, the bright spots on the equator with $9^h\ 50\frac{1}{4}^m$, and the dark, irregular spots ranged along the belt north of the equator with $9^h\ 48^m$. Further observations may reveal other phenomena of equal importance; and it is certain that the time has come when this planet will be subject to the constant and critical examination which the marvellous variations in his appearance so obviously demand.'

M. Bredichin is of the opinion that all the recent phenomena presented by the planet *Jupiter* can be explained by supposing that there is an elevated equatorial belt to the planet, and that there is more heat radiated from the southern hemisphere of the planet than from the northern.

Lately an interesting investigation has been published by Herr Harzer, giving the results of his investigation of the perturbing action of this giant planet, *Jupiter*, on the motion of Brorsen's comet of 1846, on the occasion of the very close approach of the comet to *Jupiter* in May 1842. Herr Harzer

has ably calculated the great changes in the orbit of the comet produced by the attraction of this giant planet, the principal being a change in the mean anomaly of nearly two degrees in the vectorial angle or eccentricity of a degree, and in the inclination of about two degrees. He also calculates the form of the orbit in which the comet must have moved prior to its close approach to *Jupiter*, and shows that the elements resemble those of a comet discovered by Messier in 1798. He does not think it likely, however, that the two comets are the same. Herr Harzer thinks that there is reason to believe that the orbit of the comet would have suffered similar great changes in 1760, and may undergo similar changes in its near approach in 1937.

On November 20, 1880, Mr. J. Birmingham observed the star B D + 2°, 97 quite close to the planet *Jupiter*, being distant only by 4″·05, and giving to the planet all the appearance of having five satellites. The light of the star was, however, very different from that of the satellites; and, though it is a 7·7th magnitude star, it shone only like a 10th magnitude star, owing to its proximity to the bright planet.

Swift's Comet = Comet e, 1880.—The later observations which have been made of this comet have seemed to materially alter the earlier impression about its orbit. Instead of having a period of eleven years, it seems that there can be no doubt that its period is really only half of this, or about five and a half years; but owing to the position of its orbit the comet is invisible at every other return to perihelion. The latest and best orbit seems to be that by Mr. Winslow Upton of Washington. He finds as follows:—

Epoch 1880, Oct. 25·5, Washington mean time.

1880 {
M = 357° 48′ 49″·3 = Mean Anomaly at Epoch.
☊ = 296 41 55·4 = Longitude of Ascending Node.
W = 106 18 13·8 = Distance of perihelion for Ascending Node.
i = 5 31 3·5 = Inclination of orbit.
e = 0·67594 = Eccentricity.
a = 3·29942 = Semi-major axis.
μ = 592″·0373 = Mean Motion.

From these figures we learn that the comet passed through its perihelion on November 7·79433 Washington mean time, and has a period of 2189·1 days, or only 2·4 days short of six years. This result is in close accord with that calculated by Prof. Frisby from less perfect data. The period of this comet is so nearly equal to half that of the planet *Jupiter*, and its orbit approaches so close to that planet, at a time when that planet is not far distant, that the comet must undergo considerable perturbation in its motion.

Pechüle's Comet = Comet f, 1880.—On Dec. 16, 1880, Herr Pechüle discovered a comet not far from the place of Hartwig's comet. It was small, and at the time of its discovery pretty bright. It soon grew faint, however. According to Prof. Young this comet had two tails, the upper and brighter one was directed towards the Sun, and about 40′ in length; the other, or fainter, tail was only about two-thirds as long. They were too faint to be seen after the 22nd. From the observations Mr. C. S. Chandler has computed an orbit. The elements he obtained were :—

T = 1880, Nov. 9·4087, Washington Mean Time.

λ = 263° 0′ 13″ Longitude of Perihelion.
Ω = 249 38 44 Longitude of Ascending Node.
i = 60 41 24 Inclination.
log q = 9·830884 Log of Perihelion distance.
Motion direct.

Mr. Chandler remarks, 'The orbit of this comet presents a curious general resemblance to that of 1807, memorable from the elaborate investigation by Bessel, whose results indicated a period of 1483 years, and could not be reasonably satisfied with a period of less than 700 years.'

A New Suspected Extension of the Milky Way.—An interesting account has been published by Mr. Arthur Searle, one of the assistant astronomers at the Harvard College Observatory, U.S.:—

'During the last five years I have become convinced by repeated observations that a very faint, but permanent band of light extends from *Aquila* to the *Pleiades*, passing through *Aquarius* and the southern part of *Pisces*. Since a considerable part of its course lies near the ecliptic, it may interfere to an appreciable extent with observation of the Zodiacal Light, and may be worth mentioning on this account. . . . I have consulted several works likely to contain information on similar subjects without finding any notice of it, and its presence seems not to have been generally recognized, if at all. Other observers here have seen parts of it favourably situated for observation at the time when pointed out to them; but fuller and more independent observations are of course required to furnish satisfactory evidence of its existence. As I see it, its width is about 5°, and a line drawn along the middle of the band will begin between α and δ *Aquilæ*, and pass between α and β *Aquarii*, nearly through χ *Aquarii*; thence crossing the ecliptic it will pass near 27 *Piscium* and ν *Piscium*, and will end after recrossing the ecliptic in the faint extension of the Milky Way towards the *Pleiades*. The colour of this luminous band seems to me whitish, not yellowish like the brighter parts of the Zodiacal Light. . . . If other observers should concur in my opinions with regard to the existence and course of this luminous band, it will be a question of some interest whether telescopic stars are unusually abundant along it. This would of course afford the simplest explanation of any phenomenon of the kind.'—*Ast. Nach.*, No. 2358.

Parallax of α and β Centauri.—Herr C. W. Moesta has lately carefully reduced the great number of observations of these stars made at Santiago, in Chili, during the years 1860–1864. From his results he deduces a parallax for α_2 *Centauri* of + 0″·579, and for β *Centauri* of 0″·2096, the difference or relative parallax of the stars being 0″·369, which is somewhat less than that found from the observations made at the Cape.

Parallax of the Star Piazzi III. 242.—Nearly twenty years ago attention was directed by Otto Struve to the desirability of determining the parallax of this star as it forms a wide binary pair with its neighbour, 50 *Persei*, some 15′ distant, and is itself a binary double. Dr. Ball has lately taken up this investigation, but with disappointing results, as the parallax comes out with a very small negative quantity. It is obvious, therefore, that this star has no sensible parallax. It would really seem worth ascertaining whether its binary neighbour, 50 *Persei*, also gave a similar result.

BOTANY.

The Markings of Diatoms.—M. W. Pring has sent us a copy of a paper communicated by him to the *Société Belge de Microscopie* (*Mem.* tome vii.), containing descriptions of some sections of Diatoms. He obtained his sections by making thin slices of a diatomaceous rock from Nykjobing, in Jutland, and his observations relate chiefly to three species, namely, *Coscinodiscus oculus-iridis*, *C. excentricus*, and *Trinacria regina*. In the first and third of these he finds that the markings of the valves are true alveoli traversing the thickness of the outer layer, and terminating against the inner layer, which is also perforated by smaller apertures.

Elongated Spiral Cells in the Leaves of Crinum.—M. Trécul finds that in the leaves of some forms of *Crinum*, especially *C. americanum*, there are large spiral cells with the aspect of spiral vessels, either isolated in the parenchyma, or collected into more or less numerous groups. The blade of the leaf shows numerous parallel fibrovascular bundles, which become thicker in the direction of the thickness of the leaf towards the middle of the blade; between them are vacant spaces formed by the destruction of the parenchyma, but interrupted by transverse dissepiments of parenchyma uniting the neighbouring bundles. The spiral or tracheiform cells described by M. Trécul, occur in all parts of the parenchyma of the leaf, but nowhere else in the plant. They attain a considerable length, but in this respect vary greatly. M. Trécul indicates a range of length of from 0·50 to 13·40 millim., in the same species. Two of them were observed to be forked. The number of spiral cells is much greater in *Crinum americanum* than in *C. taïtense;* in fact, these two species may be distinguished by the characters furnished by these cells. *C. africanum* comes nearer to the American species. M. Trécul suggests the question whether the plants presenting the above-mentioned anatomical character, which is not shown by the other *Crina*, are to be regarded as having the same specific origin. If they had a common origin they have undergone considerable modifications; the Tahitian plant, especially, differing very widely from the American. On the other hand, *C. taïtense* being identified by Herbert and Kunth with Rob. Brown's *C. pedunculatum*, which they regard as the first variety of *C. australe*, and therefore allied to *C. rubricaule*, *exaltatum*, and *canaliculatum*, the three other varieties of *C. australe*, it would be interesting to ascertain if all these forms possess the same character of the presence of spiral cells in the parenchyma of the leaves.—*Comptes Rendus*, 4 *February and* 7 *March*, 1881.

GEOLOGY AND PALÆONTOLOGY.

South African Triassic Reptiles.—In a paper read before the Geological Society in April last, and since published in the Quarterly Journal of the Society (Vol. xxxvi. p. 414), Prof. Owen described the remains of a reptile of his order Anomodontia, from the trias of Graaf Reinet, in South Africa, which he considered to show strong resemblances to the lower forms of the Mammalia. The fossils consisted of some thoracic vertebræ, with portions

of ribs, a sternal bone, a scapula, and a right humerus, found imbedded in one mass of rock, and of a femur and phalanges, and a pelvis in another mass. With the exception of the pelvis, Prof. Owen described these bones in detail. The vertebræ agree most nearly with those of *Dicynodon*, and *Oudenodon*. The supposed sternal bone is of a rounded hexagonal form, and is regarded by Prof. Owen as the anterior bone of the sternum proper, which is usually unossified in recent lizards, but well ossified in *Ornithorhynchus*. The scapula also presents resemblances to that bone in *Ornithorhynchus*. The humerus in its general proportions, and especially in the great development of its ridges, was also shown to resemble the same bone in the Monotremes. The ungual phalanges were described as broad and obtuse, probably constructed to bear claws adapted for digging, as in *Echidna;* the femur also resembles that of the last-named animal.

Prof. Owen remarked upon these approximations to the Monotrematous Mammalia, in allusion to which he proposed the name of *Platypodosaurus robustus* for this animal, the humerus of which was 10½ inches long and nearly 6 inches broad at the distal end. He also alluded to the interesting problems opened up by the study of these South-African reptiles in connexion with their possible relationships to the low implacental Mammalia of New Guinea, Australia, and Tasmania.

Subsequently the pelvis was freed from the matrix, and Prof. Owen communicated a description of this part of the skeleton to the Geological Society (9th March, 1881). The fossil includes the sacrum, the right 'os innominatum,' and a great part of the left ilium. There are five sacral vertebræ, which Prof. Owen believes to be the total number in *Platypodosaurus*. The neural canal of the last lumbar vertebra is eight lines in diameter, and of the first sacral nine lines, diminishing to six lines in the fifth, and indicating an expansion of the myelon in the sacral region, which is in accordance with the great development of the hind limbs. The sacral vertebræ increase in width to the third; the fourth has the widest centrum. The coalescence of the vertebræ justifies the consideration of the mass, as in Mammalia, as one bone or 'sacrum,' which may be regarded as approaching in shape that of the Megatherioid Mammals, although including fewer vertebræ. Its length is 7½ inches; its greatest breadth, at the third vertebra, 5½ inches. The ilium forms the anterior and dorsal walls of the acetabulum, the posterior and postero-ventral walls of which are formed by the ischium and pubis. The diameter of its outlet is 3 inches, the depth of the cavity 1½ inch, and at its bottom is a fossa 1⅓ inch broad. The foramen is subcircular, 1 inch in diameter. The ventral wall of the pelvic outlet is chiefly formed by the pubis; it is a plate of bone 6 inches broad, concave externally, convex towards the pelvic cavity. The subacetabular border is 7–8 lines thick; it shows no indication of a pectineal process, or of a prominence for the support of a marsupial bone. Prof. Owen remarks that of all examples of pelvic structure in extinct Reptilia this departs furthest from any modification known in existing types, and makes the nearest approach to the Mammalian pelvis. This is shown especially by the number of sacral vertebræ and their breadth, by the breadth of the iliac bones, and by the extent of confluence of the expanded ischia and pubes.

At the same meeting Prof. Owen described another new South African

reptile from the Trias of Gough, in the Karoo District of South Africa, which he also considered to show strong tendencies towards the Mammalia; but this species he refers to the Theriodont Reptiles, and hence its approximation to the Mammalia would seem to lead in the direction of the Carnivorous Marsupials.

This new type, described by Prof. Owen under the name of *Ælurosaurus felinus*, is represented by the skull with the lower jaw, but with the post-orbital part broken away. There is a single nasal opening (mononarial); the alveolar border of the upper jaw is slightly sinuous, concave above the incisors, convex above the canines and molars, and then straight to beneath the orbits. The alveolar border of the mandible is concealed by the overlapping teeth of the upper jaw; its symphysis is deep, slanting backward, and destitute of any trace of suture; the length of the mandible is $3\frac{1}{4}$ inches, which was probably the length of the skull. The incisors are $\frac{5—5}{5—5}$, and the molars probably $\frac{5—5}{5—5}$ or $\frac{6—6}{6—6}$, all more or less laniariform. The length of the exserted crown of the upper canine is 12 millims.; the root of the left upper canine was found to be twice this length, extending upwards and backwards, slightly expanded, and then a little narrowed to the open end of the pulp-cavity. There is no trace of a successional canine; but the condition of the pulp-cavity and petrified pulp would seem to indicate renewal of the working part of the canine by continuous growth. The author infers that the animal was monophyodont. *Ælurosaurus* was said to be most nearly allied to *Lycosaurus*, but its incisor formula is Dasyurine.

With regard to the characters of the Theriodontia, the author remarked that we may now add to those given in his 'Catalogue of South African fossil Reptiles,' that the humerus is perforated by an entepicondylar foramen and the dentition monophyodont.

Some of the opinions expressed by Prof. Owen with regard to these Reptiles, especially as to their Mammalian tendency, and the distinctive characters of the order Theriodontia, met with some objections from Mr. Hulke and Prof. Seeley, but the facts adduced are certainly of much interest.

Batrachians and Reptiles.—Prof. Cope has some remarks (*Amer. Nat.*, August, 1880) upon his genus *Cricotus*, founded upon specimens obtained from a shale of Triassic or Permian age in Illinois, and distinguished from the rest of the Stegocephali (Labyrinthodonts) by the complete development of the centra and intercentra of the vertebræ, both of which form vertebral bodies, and, in pairs, support single neural arches. No such character has been detected in the recognized divisions of the Stegocephali; and further knowledge of the structure of the genus shows that it is the type of a distinct division of that group, which Prof. Cope defines as follows:—'Centra and intercentra subequally developed as vertebral bodies, a single neural arch supported by one of each, forming a double body. Chevron bones supported only by intercentra. Basioccipital vertebral articulation cuplike, connected with the first vertebra by an undivided discoid intercentrum.' Thus the peculiarity of the vertebral column in general is continued into the articulation of the head; and, instead of the complex atlas of the Ganocephali, there is a single body connecting occipital condyle and first vertebra. In all

probability, this single body represents *the single occipital condyle of the Reptilian skull*, a part which remains cartilaginous in the Lizard long after the basioccipital is ossified, and is a distinct element. The structure of *Cricotus* shows that it is a connate intercentrum. Prof. Cope says:—'We have now removed the last difficulty in the way of the proposition that the Reptilia are derivations of the Batrachia, viz., the difference in the cranio-vertebral articulation. But the former have not been derived from the Labyrinthodontia, as has been suggested, nor from the Ganocephala, but from the Embolomera, as I call the new order or sub-order. The order of Reptiles, which stands next to it, is, of course, the Theromorpha, which presents so many Batrachian characters, including intercentra.' The genus *Diplovertobron*, described by Fritsch from the Permian gas-coal of Bohemia, is believed by Cope to belong to the same group as *Cricotus*.

Geology of the Cape Verde Islands.—Dr. C. Dölter gives a general account of the geology of the Cape Verde Islands in a letter to Prof. Von Hauer (*Verhandl. k. k. geol. Reichsanst.* 15 February, 1881). He says the group of of islands, consisting of two separate clusters, is of volcanic origin; but in places there are also sedimentary rocks, especially limestone, as on the islands of Mayo and Bravao, which, with Santiago and the still active volcano Fogo, form the southern cluster. The unfossiliferous, dense, reddish limestones of Mayo, greatly remind one of the marbles of Trent. It would be difficult to determine their age, and for this purpose a study of the formations on the African continent would be necessary. The island of Santiago, the largest of the Archipelago, represents the remains of a very large volcano, of which the crater is still partially preserved in the Pico d'Antonio, a peak of 2450 metres in height. The great crater of the Pico d'Antonio has formed the whole island, and furnished an enormous number of lava-streams, separated by strata of tuff and rapilli. Veins are rare, and of subordinate importance. In the vicinity of the centre of eruption tuffs and breccias predominate. Besides this great volcano, there are on the margins a dozen of smaller, secondary ones, from 200 to 400 metres in height. The products of the volcano are rocks which may be characterized as andesites, olivine-basalts, and phonoliths, although, of course, their precise composition can only be ascertained by careful examination. As inclusions in the volcanic rocks, there are lumps of limestone converted into marble, and containing materials like serpentime and chlorite, and also phyllite, mica-schist, diorite, diabase, &c. The marbles are the most interesting of these, as such contact formations have hitherto rarely been observed in recent volcanoes.

Of the northern group Dr. Dölter has only examined the volcano of San Vicenti, a great volcano the former crater of which forms the harbour of the island. It consists chiefly of lava-streams, which fall towards the sea uniformly at a gentle inclination. Between them are masses of tuff of subordinate importance, with numerous veins. The margin of the crater has an elevation of about 1200 metres. In the midst of the crater Dr. Dölter found, to his great surprise, masses of dioritic and diabase-like rocks from two to three kilometres in length and breadth, some of them resembling hypersthenite; they were penetrated by veins of basalt and andesite, the rocks forming the volcano, and overtopped by lava-streams. Dr. Dölter thinks it probable that in these we have masses of the ancient continent, the existence

of which seems to be proved by the occurrence of masses of schist in the limestone.

Ancient Eruptive Rocks of the Puy-de-Dôme.—M. A. Julien has communicated to the French Academy (*Comptes Rendus*, 28th March, 1881) some observations on the ancient eruptive rocks of the great plateau which bears the more modern volcanic formations of the Puy-de-Dôme. His statement will probably be interesting to travellers in the Auvergne who pay attention to geology. The rocks found are as follows:—Porphyroid granite, ordinary granite with grains of moderate size, leptynite (granulite of M. Lévy), pegmatite with tourmaline and garnets, amphibolic rocks, diorite, amphibolite, and amphibolic petrosilex. The porphyroid granite forms vast expansions, but all the other rocks are in the form of veins, which are very numerous and distinctly marked. The veins of leptynite and pegmatite have a general north and south direction, with slight deviations to the east and west. The veins of amphibolic rocks, on the contrary, generally run W.N.W.

The order of appearance of these rocks was as follows:—First came outflows of porphyroid granite, which is the most ancient granite of the region; then granite with moderate-sized grains in strong veins in the porphyroid granite; then the veins of diorite. During the emission of the latter, amphibolic granites were injected between Aydat and Phialeix, and these again were traversed by veins of rose-coloured and green amphibolic petrosilex. Innumerable veins of leptynite afterwards appeared, and the pegmatites concluded the series of eruptive phenomena. The last two rocks are always quite distinct.

The author states that all these relations are recognizable with the greatest clearness in many parts of this magnificent plateau; but he indicates certain points which he thinks of the most interest.

1. At the Côtes de Ceyrat, along the road which ascends the flanks of the granite cliff to Berzet, the porphyroid granite contains enormous blocks of Cambrian schists. Very distinct veins of ordinary granite, some of them several metres thick, traverse the porphyroid granite. One of them in its course traverses one of the enclosed blocks. Veins of leptynite traverse both granites, and one of them also cuts through the same block of schist already traversed by the ordinary granite.

2. In the quadrilateral included between Theddes, Chadrat, Saint-Genès, Champanelle, and Berzet, the porphyroid granite encloses hundreds of Cambrian fragments, into which it is also injected in branching and anastomosing threads and veins penetrating the fissures of the blocks. The granite must therefore have been extremely fluid at the time of its production. There is no trace of metamorphism; innumerable N. and S. veins of leptynite and pegmatite traverse the whole system.

3. Near Recolène, at 100 metres in front of the village, a magnificent vein of diorite enclosed in Cambrian quartzite, is distinctly cut through by a vein of leptynite 20 centimetres thick.

4. Between Santeyras and Aydat, on the margin of the lake, there is on the road, 100 metres from Santeyras, a thick vein of diorite running N. 50° W. traversing the porphyroid granite and a large included mass of schist. This is in its turn cut by a vein of tourmaliniferous pegmatite 20 centimetres in thickness.

5. Near the last house in the village of Theddes a vein of leptynite, 30 centimetres thick, is cut nearly at right angles by a vein of pegmatite with tourmaline of about equal size.

The formation of all these rocks is considered by the author to have taken place during the Silurian epoch.

PHYSICS.

A Note on the Determination of the Magnetic Inclination in the Azores is communicated to the Proceedings of the Royal Society by Dr. Thorpe. He notes that except a series of similar observations made by the officers of the *Challenger* in 1873, none have been made since Captain Vidal's survey in 1843. Magnetic observing is difficult in these islands, from the intensely volcanic nature of the strata. The dip-circle used was lent from Owens College, Manchester. In the island of St. Michael the mean dip was 62° 40′·2 N., against 63° 56′·8 N. of the *Challenger*. In Terceira it was 64° 10′·3, and in Fayal 63° 38′·5.

The Thermo-electric behaviour of Aqueous Solutions, with Platinum Electrodes, has been further studied by Dr. Gore, in continuation of his memoir, already abstracted in this Summary. To prevent suspicion of error from chemical action upon the mercury electrodes therein used, coiled ribbons of sheet platinum were substituted for mercury, all other parts of the apparatus remaining exactly similar to those employed in the former experiments. They were heated to redness and thoroughly washed. Precisely similar liquids were used as in the first researches, none of them acting chemically on platinum. These were boiled for half-an-hour to expel dissolved air. At 180° Fahr. cyanide of potassium made hot platinum 11·0 positive; whereas the same couple, with sulphuric acid 1 in 40, rendered it 4·25 negative. Between these extremes is a list of thirty-four other substances. This is compared with the former series, and the differences between the results are only in one or two cases important. The chief conclusion arrived at is that the currents previously obtained with mercury are really due to heat, and not to minute amounts of chemical action.

The same observer also contributes memoirs on the *Influence of Voltaic Currents on the Diffusion of Liquids* and on *Electric Osmose*. In the former case the phenomena are very complex, consisting of a mixture of physical and chemical effects, chiefly due to electrolytic changes, to differences of specific gravity, to ordinary liquid diffusion, to electrolytic transfer, and to heat of conduction-resistance. In the latter instance the experiments were similar to that made by Porrett. A vessel of thick glass divided vertically into two equal parts, had a diaphragm of biscuit porcelain about 1·5 millim. thick between its two cavities. The cell was held together by screw clamps. The electrodes were of sheet platinum, the current from several Grove's pint-cells in single series, always in the same direction. In sixty-eight experiments osmose occurred in all but one—a saturated solution of potassic cyanide. It was in the same direction as the electric current, with one exception, that, namely, of bromide of barium in absolute alcohol. This single fact quite

invalidates the conclusion that the direction of flow is independent of chemical composition and molecular structure of the liquid. It would appear, however, that this direction depends 'much more frequently upon the direction of the electric current than upon the internal architecture of the liquid.'

A paper complementary to this, by the same distinguished physicist, considers the *Electric currents caused by liquid diffusion and Osmose.* It states that other observers have already obtained electric currents by the contact of two liquids—Nobili the first. His arrangements consisted of a series of four glass cups, each containing an electrolyte, the liquids in the two terminal vessels being similar, with platinum electrodes; a second and third kind of liquid being in the two intermediate cups. The solutions were connected by liquids similar to those in the cups contained in glass syphons, with turned-up capillary ends. Fechner, Wild, L. Schmidt, and Wullner, all attacked the same problem in various ways. To ascertain whether difference of facility in diffusion, caused by the action of gravity upon two portions of of solution of different degrees of concentration and of specific gravity would produce a current, twenty-five small glass tumblers were taken, each alternate one containing liquid of a different degree of concentration. Potassic nitrate was the salt employed. Platinum wire electrodes completed the circuit. The liquids in the vessels were connected by means of inverted bent tubes half an inch in diameter, alternately filled with the two solutions. Where the liquids came in contact at the end of each of the tubes a wet septum of parchment paper was secured. On interposing a galvanometer a feeble current was obtained, not due to differences in the electrodes. Its direction was downwards, through the septa and surfaces of contact. With sulphate of copper and sulphuric acid, a stronger current of similar direction was obtained. Four other experiments, somewhat varied in their conditions, produced a much stronger current, in a reverse direction, from the strong solution upwards through the diaphragm into the weak one. The difference of osmose, through a porous partition, was opposite in direction to that produced by difference of diffusion.

The phenomenon of Regelation, originally discovered by Faraday in 1850, and extended in its physical bearings to explain glacier motion by Tyndall, has been recently made the subject of a memoir in the *Annales de Chemie et de Physique,* by Mons. W. Spring, Professor of the University of Liége. He adverts to the more recent researches of Helmholtz, Bottomley, and especially of Tresca, on the viscosity of solid bodies, but is of opinion that we have not yet attained a satisfactory solution of the question. James Thomson and Clausius have given mathematical expression to the physical laws involved in the phenomenon, the general cases of which have been verified experimentally by Bunsen. But two substances still form exceptions to the rule—water and bismuth. Their specific volume being greater in the solid than in the liquid state, pressure lowers, instead of raising their point of fusion. That of ice lowers 0°·0075 for each additional atmosphere of pressure. Mousson was able to melt ice completely, without the addition of any external heat, by a pressure of 13,000 atmospheres. Mons. Spring considers that the binding together of solid bodies under pressure is a much more general phenomenon, comparable to the liquefaction of gases. He has

subjected 83 substances, of which 8 were metals, 6 metalloids, 10 oxydes and sulphides, 32 salts, and 19 carbonaceous bodies, with 8 mechanical mixtures, to compression, either under ordinary or elevated temperatures, with the following among other results. Lead in a vacuum, under pressure equal to that of 2000 atmospheres, becomes as solid as when melted ; under 5000 it flows like a liquid. Bismuth welds easily under a pressure of 6000 atmospheres, breaking afterwards with a crystalline fracture. Pewter behaves like lead. Zinc requires 5000 atm. Aluminium and copper unite at 6000 atm. Antimony in grey powder recovers solidity and metallic lustre at 5000. Platina welds imperfectly with pressure alone. Of the three allotropic forms of sulphur, the transparent prismatic form at 5000 atm. became harder than that obtained by fusion, and probably octahedral, a form which the plastic variety also took at 6000 atm. The octahedral form itself welds easily at 3000 atm. Amorphous carbon refuses to solidify under any pressure whatever, and exhibits the most perfect elasticity. Graphite, on the contrary, as is well known, agglomerates to a solidity equal to the native material. Peroxyde of manganese took the exact appearance of crystalline pyrolusite. Alumina became translucent, like the mineral known as Halloysite, flowing like a liquid, but showing no tendency to assume the form of corundum. Sulphide of lead became galena. Many chlorides, bromides, and iodides welded and became transparent. Mercuric iodide took a violet colour. Nitrate of potash became plastic like wax at 3000 atm., as did hyposulphite of sodium. Glass resisted at every pressure. Turf became practically coal, losing all trace of organic structure, and coking in a close vessel just like coal, a result of some geological importance.

Pressure was also found to influence chemical combination. For instance, under a pressure of 5000 atms. sulphur and metallic copper combine perfectly. Mercuric chloride and the same metal change places, metallic mercury and cuprous chloride, free from cupric chloride, being left.

M. Spring points out (1) that under compression, the attraction of particles follows the direction of the crystalline axes; (2) that crystalloids coalesce better than amorphous bodies; (3) that after welding, many bodies reputed solid flow like liquids. The compressing apparatus is described as consisting either of screws or powerful levers weighted at their end. Hydraulic compression is not alluded to.

Musical pitch and its determination formed the subject of a recent lecture at the Royal Institution by Dr. W. H. Stone. He pointed out that absolute pitch does not exist in nature, the exceptional power of recognizing a note, or hearing it, being really an acquirement connected with the 'muscular sense' in singers, and musical memory highly developed in organists and instrumentalists generally. After defining pitch as rapidity of vibration, he considered (1) the causes and amount of variation in different sound-producers; (2) scientific methods of measuring pitch; (3) the musical application of such methods.

1. Heat variations were illustrated by metallic strings, organ-pipes, harmonium-reeds, and tuning-forks.

2. The mechanical, optical, photographic, electrical, and computative methods of determining pitch, were exhibited and explained. These included

an exact copy of Colonel Perronet Thompson's *Monochord*, bearing a weight of 240 lbs. to produce Tenor C, and Professor McLeod's ingenious modification of Lissajous's figures in the cycloscope. He laid much stress on the computative method, on account of its extreme simplicity and accuracy. By it absolute was first obtained from relative pitch. Scheibler's *Tonmesser* and Appunn's reed-tonometer were exhibited, as well as a photograph of Kœnig's tuning-fork clock.

3. The problem of absolute pitch having now been satisfactorily determined, its application only needed time and patience, the present state of the matter being discreditable to England. Since Handel's time, pitch had risen about a semitone. This was attributed to (1) the excess of true fifths, as tuned to by violins, over the corresponding octaves; (2) the rise with heat of the wind instruments; (3) the difficulty of appreciating slow beats; (4) the predominant effect on the ear of a sharp over a flatter note. The voice—God's instrument—should be consulted in preference to man's less perfect instruments. The difference, however, between the present high orchestral pitch and the French normal diapason which, as a standard, had been proved to be both accurate and convenient, is less great melodically than is often supposed. Indeed the ear, unassisted by beats, was all but unable to detect the difference. The main need of modern music was a greater familiarity with the physical principles upon which it rests.

ZOOLOGY.

Abyssal Crustacea of the West Indies.—Prof. A. Milne-Edwards has laid before the French Academy of Sciences a general statement of the results of his investigation of the Decapod Crustacea dredged up from great depths in the West Indian seas, by the U. S. exploring ship *Blake* (*Comptes Rendus*, 21 February, 1881).

The family Galatheidæ has always been regarded as wanting in American waters; among these collections there are forty-one species, mostly constituting new genera, although thirteen of them belong to the widely distributed genera *Galathea* (2) and *Munida* (11). True Crabs do not occur at very great depths; numerous small species are found down to about 250 fathoms, and at about 400 fathoms a new form allied to the well-known European genus, *Gonoplax*, was obtained. This animal, deecribed by Prof. Milne-Edwards under the name of *Bathyplax*, is blind, its eyes being atrophied and destitute of facets, and its orbits rudimentary. The Anomurous and Macrurous Decapods, on the contrary, swarm at great depths. Down to about 1800 fathoms the curious genus *Willemoesia* was represented; its species are apparently most nearly related to the well-known Eryons of the Jurassic rocks, but the deep-sea forms examined by M. Milne-Edwards were blind. The Galatheidæ already mentioned occurred at still greater depths, down to more than 2000 fathoms, from which depth came species of a new genus (*Galathodes*) having the eyes greatly reduced and imperfectly facetted. The most interesting types are those belonging to the family Paguridæ, represented hitherto by the well-known Hermit Crabs, which,

although numerous in species, are all very similar and show no indications of an alliance with the Macrura, such as the Shrimps and Lobsters. Among the West Indian dredgings, however, such intermediate forms seem to abound. Thus *Pylocheles Agassizii* is described as connecting the Hermit Crabs with the Thalassinidæ; the abdomen, instead of being soft and unsymmetrical as in the former, is composed of firm, regular rings, and terminated by a symmetrical fin. This animal lives in holes, the entrance to which it closes with its claws. In *Mixtopagurus*, the abdomen is more developed on the right than on the left side, and divided into seven joints, of which the first five are imperfectly calcified, and the last two large and hard. In *Ostraconotus* the carapace is coriaceous, and the abdomen so small that the female uses the legs of the fourth pair to hold her eggs; the last joint but one in these limbs is widened into a palette forming a floor on which the eggs rest. *Spiropagurus* and *Catapagurus* have a very small, twisted abdomen which the animals lodge in small spiral shells, contrasting curiously with the much larger carapace and legs which remain exposed. *Eupagurus discoidalis* inhabits the tubular shells of *Dentalium*, the orifice of which it closes with its claws. *Xylopagurus* inhabits holes in fragments of wood and the cavities of reeds, rushes, &c.; the cavities are open at both ends, and the Crustacean does not go into its dwelling tail foremost after the fashion of the Hermit Crabs, but crawls in and closes one aperture with its claws and the other with the end of the abdomen which is converted into an opercular shield. Among the Dromiidæ there are numerous forms leading towards *Homola* and its allies, and the genus *Homola* itself is represented by two species, one of which appears to be identical with the Mediterranean *H. spinifrons*, thus furnishing a striking example of the wide distribution of animals inhabiting the great depths of the sea. The genus *Cymopolia*, of which one species inhabits the Mediterranean, possesses eight in the Caribbean Sea. The genus *Ethusa*, supposed to be peculiar to the Mediterranean, is also found in the American seas; M. Milne-Edwards has described a species from the Florida reefs under the name of *E. americana*, but states that it differs from the Mediterranean *E. mascarone* only by characters of little importance.

It is impossible to overrate the value of such results as the above, and M. Milne-Edwards is quite justified in commenting with some pride upon the important bearing which such investigations must have upon our conceptions of the system of Nature. As one instance of this, he indicates that the results of the *Travailleur's* expedition of last year in the Bay of Biscay showed the existence, in close proximity on the Spanish coast and in the neighbouring deep water, of two distinct faunas belonging neither to the same time (geologically speaking) nor to the same climate; and he specially calls the attention of geologists to this fact as showing that at the present day and in the same seas, there must be in course of formation deposits absolutely contemporaneous, but which will contain the remains of perfectly dissimilar animals. The littoral deposits will contain the types of higher organizations; the deposits formed at great depths will contain creatures of a more ancient character, some of them presenting unmistakable affinities with fossils of the secondary epoch, while others resemble the larval forms of existing species.

We are glad to learn that the success of last year's expedition will induce

the French Government to send out the *Travailleur* again this summer on a dredging expedition; this year the scene of her labours will be the Mediterranean.

The Crustaceans referred to above are described by Prof. Milne-Edwards in the Bulletin of the Museum of Comparative Zoology in Harvard College, Vol. viii., No. 1.

Terrestrial progression of Callichthys.—According to Mr. Joseph Mawson of Bahia (*Science*, December 25, 1880), the Brazilian Siluroid fish, *Callichthys asper*, is very active on dry land. Mr. Mawson says:—'During the rainy season the fish live in fresh-water pools. When the pools dry up in the dry season, they bury themselves in the mud, and remain there until the rains return the following year. They are noted for overland excursions. It is said that they are often met with going from one pool to another. I have had six of the fish in a narrow-necked tin of water, with some sand and mandioca meal at the bottom, for five days, and they continue active and vigorous, especially the smaller ones. These examples measure from 5 to 10 cm. in length, and I have seen them much larger. I have had them out in the garden several times. I find that they move best on smooth damp ground, and are embarrassed by sticks or other inequalities. They can jump a little vertically, but their progress on land is effected entirely by a quick wriggling motion of the body, which is nearly flat upon the ground. The paired fins (pectorals and ventrals) are extended laterally, and seem to bear little if any weight; but they move slightly, and appear to serve to steady the body. Last night I heard a peculiar sound, and on looking around, I saw one of the fish travelling about the room. He had escaped from the tin which was in my bed-room, had fallen from the table to the floor, and travelled along the corridor, about 12 metres (about 40 feet), to the *sala*. I watched him travelling for two hours, during which time I estimate that he moved at least 90 metres. Toward the end of the two hours he seemed to flag a little, but in the earlier part his method and speed were fairly seen. He seemed to start with a sudden movement of the head or the barbels, then wriggled briskly for 5 to 10 seconds, advancing about a metre. Then he would rest for about 10 seconds, and start as before. This was kept up during the whole two hours, and I left him still moving. This morning, five hours later, I found him dead. While he was moving I spilled some water on the floor, but he crossed it; hence I concluded that it was mud rather than water of which he was in search.'

Trichinosis.—The spread of *Trichinosis* in American pigs is producing very serious consequences, not only in North America, but also in Europe, owing to the great importation of pork, hams, &c., from the United States. In France considerable alarm prevails, and the most opposite opinions seem to be held—some writers maintaining that ordinary salting is sufficient to destroy the *Trichinæ*, whilst others declare that salting, smoking, and even ordinary cooking, will not give the requisite safeguard. M. J. Chatin (*Comptes Rendus*, 28th February, 1881), declares that the examination of the encysted *Trichinæ* in salted provisions seems to show that these parasites are in a state of absolute functional integrity, for he says, 'We know that their passage from latent life to death is regularly manifested by important modifications in the nature of the cyst; fatty matter accumulates rapidly,

then calcareous granules appear and multiply quickly, effacing all traces of the original constitution.' None of these phenomena were presented by the *Trichinæ* observed by him. The ordinary course of experiment to decide whether the *Trichinæ* are really alive consists in heating the trichinized meat to 40° or 45° C. (104° or 113° F.), and then examining whether the encysted larvæ show any signs of movement. If not, the meat is regarded as innocuous; but M. Chatin holds that this conclusion must be accepted with reserve, seeing that the action of heat only reproduces one of the conditions necessary for the ulterior development of the parasites. His own test consisted in the administration of small quantities of trichinized salt pork to two guinea-pigs. On the fourth day diarrhœa set in, and rapidly increased; on the eighth day one of the animals died, and the other on the fifteenth day. Examination showed all the signs of acute enteritis; and further, the intestine contained numerous adult, sexually mature *Trichinæ*. The females showed normally developed embryos, which were also met with free in the contents of the intestine. In the guinea-pig that survived till the fifteenth day, young *Trichinæ* had already got into the muscles, but had not yet become encysted.

M. Bouley (*Comptes Rendus*, 7th March, 1881) seems to think that there is little danger of the spread of trichinosis in France, and accounts for this supposed immunity by the fact that such provisions as might communicate the parasite are thoroughly cooked in that country, the *Trichinæ* not being able to survive exposure to a temperature of 70° C. (158° F.). In spite of such encouraging statements, the French public appear to prefer having their pork untrichinized, and M. Bouley himself has been appointed by the Government to organize a system of inspection at Havre.

A Gigantic Japanese Cuttlefish.—M. Hilgendorf describes (*Sitzungsber. Gesellsch. Naturf. Freunde zu Berlin*, 1880) a gigantic Cuttlefish, which was captured in the Japanese sea in 1873, and exhibited in Yedo for money as a curiosity. It did not attain the size of the specimens obtained some years ago off the coast of Newfoundland, some of which were estimated to exceed 50 feet in total length, including the long tentacular arms, while indisputable measurements of one specimen give the length of the body as 9½ feet, and that of the long arms at 30 feet, making nearly 40 feet in all.* The Japanese Cuttlefish was, however, a sufficiently formidable animal; the length of its body (the head estimated) was about 7½ feet, and that of the longest arm preserved, 6½ feet. The long tentacles had been cut off, but M. Hilgendorf estimates that when they were perfect, the total length of the animal must have been at least 20 feet. He was at first inclined to refer this Cuttlefish to the genus *Ommastrephes*, but, on further consideration, makes it the type of a new genus, and names it *Megateuthis Martensii*. The generic name is already preoccupied by Mr. Savill Kent's *Megaloteuthis*, proposed for one of the Newfoundland specimens, and it is a question whether the characters indicated by M. Hilgendorf are sufficient to separate the Japanese species generically from *Architeuthis*, Steenstr. Nevertheless the record of the occurrence of a gigantic squid in the Japanese seas is of interest.

The Organs of Taste in Fishes.—M. E. Jourdan has presented some remarks upon this subject to the French Academy (*Comptes Rendus*, 21st March, 1881).—Schulze nearly twenty years ago described certain cyathiform bodies

* See some observations of Prof. Verrill's, p. 190.

in the Barbel and in the tadpoles of *Pelobates fuscus*, which he found to agree in structure with similar bodies in the tongues of Mammalia, and was led to believe that the two sets of bodies possess the same functions. M. Jourdan has investigated several fishes, and especially the Malarmat (*Peristedion cataphractum*) at the Marine Zoological Laboratory of Marseilles, and his observations confirm Schulze's conclusions. The Malarmat (a member of the Gurnard family) possesses barbels like those of the Red Mullet (*Mullus barbatus*), and free fine rays identical with those of the Gurnards. The barbels, which may be either tufted or isolated, are attached, to the number of ten or twelve, to the lower jaw; two of them are always large, and present secondary ramifications. They are always furnished with small cyathiform bodies containing two kinds of cells; some, grouped in the centre, and slightly projecting at the surface of the barbel, resemble fibres with a voluminous nucleus; the others, arranged at the periphery, are cylindrical. These organs exist also in considerable number in the mucous membrane lining the cavity of the mouth: they are arranged serially in the pharynx, and the papillæ of the rudimentary tongue have three or four of them. They are always in the epidermis.

In the Mullet the cyathiform bodies are much larger. They are like those described by Schulze in the Barbel and Tench. Each corpuscle is placed at a point in the epidermis corresponding to a papilla of the dermis; it is clearly distinguished from the cells which surround it by the dark colour it acquires by the action of osmic acid, and the aspect of the elements forming it. Each is formed of cells of two types, between which all transitional forms are observed; namely, cylindrical, peripheral cells, and cells grouped in the centre of the ovoid body, which terminate in conical processes, the points of which are not so distinct in the Malarmat. All possess a voluminous nucleus. At the base of each corpuscle is a small granular mass formed by the varicose basal prolongations of the cells of the body; in the granular mass the cylinder-axes of the nervous fibres disappear, and the cells of the corpuscles originate. Identical bodies occur in the mucous membrane of the tongue and pharynx.

The Gurnards have cyathiform corpuscles on the tongue; and they probably exist in the buccal mucous membrane of most fishes.

If these cyathiform bodies are to be regarded as taste-organs, whether external or internal, the sense of taste appears to acquire an importance in fishes which may be justified by the nature of the medium in which the animals live. 'The search for food,' says the author, 'must be guided by sensitive terminations more particularly destined to the reception of gustative emanations; this explains the distribution of the cyathiform corpuscles upon external organs, exploratory apparatus, the situation of which has deceived observers, but which need no more surprise us than the existence of well-formed otoliths, far from the head, upon the last segments of *Mysis*.'

Giant Squids on the Newfoundland Banks.—Professor Verrill has published (*Amer. Journ. Sci.*, March, 1881) an account of the occurrence of Giant Squids of the genus *Architeuthis* in great abundance upon the Grand Banks in the year 1875. He states that he has been informed by Capt. J. W. Collins that in October of that year a great number of these animals were found floating at the surface over the Grand Banks, mostly quite dead, and more or less mutilated by birds and fishes. In a few cases they were not

dead, but completely disabled. They were seen chiefly between 44° and 44° 30′ N. lat., and between 49° 30′ and 49° 50′ W. Long. From twenty-five to thirty specimens were said to have been secured by the fleet from Gloucester, Mass., and as many more were probably obtained by the vessels from other places. They were cut up as bait for codfish. Capt. Collins himself was in command of the schooner *Howard*, which secured five squids to her own share. They were mostly from ten to fifteen feet long, exclusive of the arms, and averaged eighteen inches in diameter. The arms were generally mutilated, the portions left being usually three or four feet long, and, at the base, almost as thick as a man's thigh. One specimen, when cut up, was packed into a large hogshead-cask holding about 75 gallons, which it filled. This cask would hold 700 pounds of codfish, and as the specific gravity of the *Architeuthis* is almost equal to that of codfish, we may take this as an approximate indication of the weight of one of these gigantic Cephalopods. Allowing for the lost parts of the arms, this specimen would probably, when entire, have weighed about 1000 pounds; previous estimates are too high.

Professor Verrill refers to other vessels which secured portions of the valuable supply of bait furnished by these great squids, and states that the *E. R. Nickerson*, Capt. McDonald, obtained one which had its arms, and was not quite dead, so that it was harpooned. Its tentacular arms were thirty feet long. The schooner *Tragabigzanda* secured three in one afternoon; they were from eight to twelve feet long, not including the arms. Other fishermen confirm these statements, and some of them add that the 'big squids' were common during the same season at the 'Flemish Cap,' a bank some distance north-west of the Grand Banks.

With regard to the cause of this remarkable mortality among these great Cephalopods, Professor Verrill suggests that it may have been due to some disease epidemic among them, or to an unusual prevalence of deadly parasites or other enemies. He indicates, however, as a point worthy of notice, that they were observed at the same season of the year when most of the specimens have been found on the shores of Newfoundland. This season may, perhaps, be immediately subsequent to the period of reproduction, when the animals would probably be so much weakened as to succumb easily to parasites, disease, or any other unfavourable conditions.

Disappearance of the muscles of larvæ in the pupæ of Dipterous Insects.—It is well known that many of the internal organs of the larvæ of insects melt away, as it were, when the insect passes into the pupa state, so that the pupa may not unaptly be likened to a second egg in which new organs are produced from a formative fluid. M. Viallanes has communicated to the French Academy (*Comptes Rendus*, February 21) an interesting description of his observations on the disappearance of the larval muscles in the pupæ of Diptera, founded upon the examination of more than 400 transverse sections of larvæ and pupæ. The primitive bundles enclosed in their sarcolemma exhibit nuclei, some of which are situated just within the sarcolemma, while others are in the midst of the contractile substances of the muscle. From the first day of pupal life the primitive bundles begin to disappear, and this disappearance takes place in two modes,—

1. By the excessive activity and proliferation of the nuclei;
2. By their degeneration and death.

In the first mode the sarcolemma speedily vanishes, the contractile sub-

stance becomes homogeneous, and the nuclei become spherical, and soon acquire the value of complete cells. They are surrounded by a layer of protoplasm, enveloped by a membrane. In this protoplasm four or five spherical granules make their appearance, and soon attain the size of the nucleus, producing a mulberry-like mass of five or six grains enclosed in a common envelope. The enveloping membrane disappears and the grains separate, and again multiply by a process analogous to that already described. As these embryonic cells increase in number the contractile substance is absorbed, and at a more advanced stage the place originally occupied by the muscular bundle shows only a mass of embryonic cells engaged in constant proliferation.

In the second mode the sarcolemma also disappears, and the muscular nuclei show a very distinct envelope presenting a double contour. They still retain their original lenticular form, and their centre is occupied by a small spherule composed of fine granules. These granules become fewer and fewer; they separate and finally disappear, when the nucleus is represented only by its empty envelope. While these changes are going on the contractile substance gradually disappears, by a sort of melting away, but without altering the general form of the bundle, finally producing a colourless, very finely granular substance, containing the original nuclei in any stage of the degeneration just described.

Habits of Callichthys faciatus.—M. Carbonnier records some curious particulars of the habits of *Callichthys faciatus*—a Siluroid fish from the rivers of South America. His observations are made upon specimens from the Rio de la Plata, living in his aquarium, and relate chiefly to the reproduction of the fish. He states that when about to deposit her eggs the female brings together the ventral fins in such a manner as to form a sort of pouch, in which the fertilizing elements furnished by the male fish are received and retained. The ovarian orifice is at the bottom of this sac, and through it some five or six eggs are extruded into the sac, where they are of course surrounded by a fluid charged with spermatozoids. To secure impregnation the female retains the eggs in the pouch formed by the ventral fins for a short time before finally depositing them. For the latter purpose she selects a spot, usually well illuminated, which she cleans with her mouth from all adhering vegetation, or other inconvenient objects, and then applying her abdomen to the place, opens the sac and attaches the eggs, which adhere by means of the viscosity with which they are endued. The same process is repeated until all the eggs—numbering about 250 for each female—have been laid. The young fish are developed and able to swim about in from twelve to thirteen days; but their further development is comparatively slow, as they do not appear to become adults until two years after hatching. A singular fact mentioned by M. Carbonnier is the change that has taken place with his *Callichthyes* in the season of oviposition since their transportation to Europe. In the Rio de la Plata the eggs are laid in October and November. After being in Europe for a year the South American specimens bred in August and September, 1878, and the young fish thus produced have their eggs in the month of June. This would seem to indicate an adaptation to the change of climate to which the fish have been subjected, the seasons in South America being the reverse of those in Europe (*Comptes Rendus*, 6 December, 1880).

Twelfth Thousand. Demy 4to. boards, price 5*s*.

HALF-HOURS WITH THE STARS

A Plain and Easy Guide to the Knowledge of the Constellations.

SHOWING IN TWELVE MAPS THE POSITION OF THE PRINCIPAL STAR-GROUPS NIGHT AFTER NIGHT THROUGHOUT THE YEAR.

WITH INTRODUCTION AND A SEPARATE EXPLANATION OF EACH MAP.

By R. A. PROCTOR, B.A., F.R.A.S.

Author of 'Half-Hours with the Telescope.'

SPECIMEN of MAPS (Size Reduced to One-Sixth).

TRUE FOR EVERY YEAR.

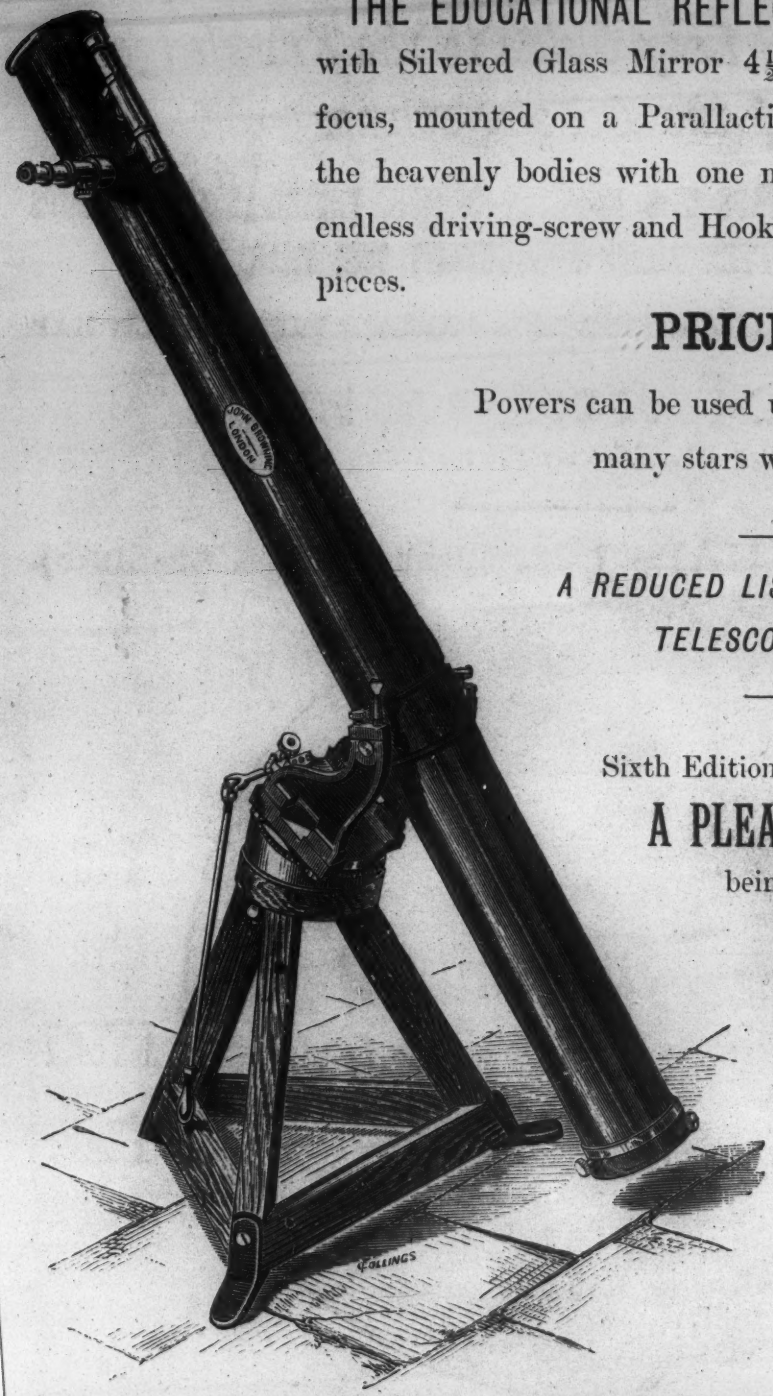
TRUE FOR EVERY YEAR.

MAP XII.

Nov. 22, at 10 o'clock.	Dec. 3, at 9¼ o'clock.	Dec. 14, at 8½ o'clock.
„ 25, „ 9¾ „	„ 7, „ 9 „	„ 17, „ 8¼ „
„ 29, „ 9½ „	„ 10, „ 8¾ „	„ 21, „ 8 „

LONDON: DAVID BOGUE, 3 ST. MARTIN'S PLACE, W.C.

BROWNING'S ASTRONOMICAL TELESCOPES.



THE EDUCATIONAL REFLECTING TELESCOPE

with Silvered Glass Mirror 4½ in. in diameter, 5 ft. focus, mounted on a Parallactic Stand for following the heavenly bodies with one motion by means of an endless driving-screw and Hook's joint, with two eye-pieces.

PRICE £22.

Powers can be used up to 400 diameters on many stars with advantage.

A REDUCED LIST OF PRICES OF TELESCOPES FREE.

Sixth Edition, with much new matter.

A PLEA for REFLECTORS;

being a Description of Astronomical Telescopes, with silvered glass specula, and instructions for using and adjusting them, with many Illustrations and Coloured Frontispiece of Jupiter.

BY

JOHN BROWNING, F.R.A.S.

One Shilling, post free.

JOHN BROWNING,

INSTRUMENT MAKER TO H.M. GOVERNMENT,

63 STRAND, W.C., LONDON.

MICROSCOPES, SPECTROSCOPES, SPECTACLES, &c. &c.